The Glass Industry
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Aiding the Progress of Glass Technology

By A. R. Payne*

Introduction

With almost all of the manufacturing industries of the present day the technique of the industry has followed and kept pace with the increase of chemical and physical knowledge of the raw materials used, their treatment and manipulation during manufacture and the results obtained by changing ingredients and methods on a predetermined scientific basis.

The glass industry, until the last quarter of the 19th century, followed nearly the same practices that it had adopted hundreds and thousands of years ago. In the midst of the age of machinery the glass house artisan presented a curious anomaly as with his age-hallowed craft he gathered, shaped and blew glass in the same manner as did the ancient Egyptians.

It was not until the beginning of the present century that a collective "brainstorm," as someone has termed it, struck the glass industry and the resulting mechanical revolution altered the entire situation.

The machines became so efficient that the tanks as they were then operated could no longer melt the glass fast enough to keep them supplied with good quality "metal." The tank temperatures were increased and since the refractories were then taxed beyond their limits, shorter and shorter tank life ensued.

Need arose for easier melting batches, for colored glasses with special properties, for stronger and more resistant glass and for glasses with properties such that they would be most suitable for working in some particular machine.

Together with his co-workers the old time glass maker had been following his own established rule-of-thumb formulae in batch making. When specialists in chemistry and glass making had met, the usual outcome had been for the scientist to explain to the factory man the chemical reasons for doing the things that he had been doing in the particular way he had been doing them. The science of chemistry as applied to glass was so young compared with glass making that there was little chance that a few well chosen words of wisdom from the chemist would be of any benefit to the factory. As a rule the established modus operandi was unchanged after such an interview.

It was not until the scientists really entered the factories and became acquainted with practical glass making that they were of any assistance to the industry.

The field of glass technology has broadened until today it covers fuels, furnaces, refractories, raw materials, glass making machines, manipulation of glass and annealing as well as the improvement of glass by altering its chemical composition.

The growth of a science cannot be forced. Although we all know that we have but started up the ladder, it is best to climb rung by rung.

When enough scientific facts have been learned about glass some genius will have an idea and after correlating and co-ordinating these facts will give us an invention or inaugurate an improved process that will pull the whole industry upward.

It is to briefly discuss the various agencies at hand and their possibilities as aids to the growth of glass technology that this paper is written.

Glass Technology in the Bureau of Standards

As the demand for optical instruments in this country has declined since the close of the war the amount of optical glass consumed has decreased until practically none is being made except that being made by the Bureau of Standards for the Navy.

It is highly desirable that the manufacture of the optical glass used in the United States be continued so that this country may never again be caught by a shortage of this military weapon.

The Bureau of Standards is an ideal place for this work to be carried on and it is not probable that the routine manufacture of optical glass will be discontinued. But additional funds should be provided so that continual research in this field may be pursued. Larger percentages of good glass from each melt may be obtained as a result of this work and new glasses may be developed which would markedly improve the

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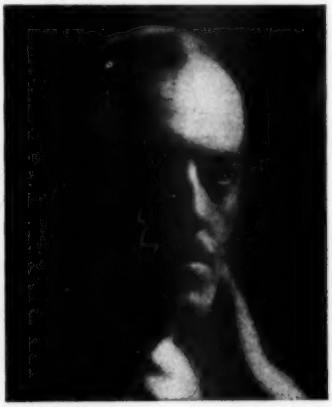
quality of optical instruments and extend their usefulness into unknown fields.

Nevertheless, we must not forget that the Glass Section of the Bureau should continue to work on the commoner glass which constitutes 98 per cent of the glass of commerce. By enabling the manufacturer of ordinary glass ware to improve his product and to increase the efficiency of his manufacturing processes the Glass Section will best serve industry.

There are certain fundamental problems dealing with the constitution, structure and nature of glass which must be solved and of all the institutions in this country the Bureau is best equipped in personnel and matériel to do this work.

The glass technologist of the future will achieve his success because of the basic work being done today by such men as Dr. Toole of the Bureau of Standards.

An ideal Glass Section for the Bureau would include physicists, physical chemists, ceramists, petrographers, combustion engineers, analysts and glass technologists. Under capable supervision research by such a combination of talent would repay its cost a hundred fold.



A. R. PAYNE

Glass Technology and the Universities

The field of glass technology offers an unlimited opportunity to the science student searching for research problems. There are dozens of these problems that can be solved only in the laboratory by hard conscientious work.

In the universities there are hundreds of students that yearly undertake special research for their M.S. and Ph.D. degrees. Too often the problems are trivial and are of academic interest only. Some scientists seem to take pride in the fact that their work is of such a nature that its results are non-applicable to industry.

While the acquisition of all knowledge is valuable and the discovery of truth in its meanest form must not be despised, nevertheless, if this effort is to be expended in some field let us use every means in our power to see that the science of glass technology comes in for its share of research work.

A few years ago I called on the head of the Department of Chemistry of one of our largest state universities. Another glass technologist was with me and it was our intention to talk "glass" with the professor for a few moments and to discuss with him the possibility of getting some of his graduate students to work on glass. Beyond this we had no axe to grind and we were not particular what phases of glass technology these students took up. All we wanted was to let him know of the problems in that field and to push work on "glass."

After hearing us for a few moments the worthy professor said "Gentlemen, glass has nothing to do with chemistry and chemistry has nothing to do with glass." With muttered apologies, we tiptoed away, fearing that any sudden movement or sound would awake the savant from his 17th century somnolence.

Where the head of a science department is a man interested in glass there is a distinct trend among his students to select the same field for their efforts.

It would be greatly beneficial to the industry to have dozens of its research problems attacked simultaneously throughout the country. Often the expense of this research would be borne by the glass companies that would benefit by its success.

Ultimately it would benefit the universities fostering such an extension of their work, for the public would learn that it was not always necessary to wait a couple of generations for discoveries in academic or theoretical science to migrate to the field of applied science and be utilized.

It is probable that after the completion of the work that the student could, if he wished, join the scientific staff of some one of the glass companies that had become cognizant of his existence through his work on glass.

At the present time there is no co-ordinated course in glass technology being offered at any college or university in the country. One is being projected at the University of Pittsburgh but it is problematical when it will materialize. The glass technologists at large at the present time are hybrid products of the fields of ceramic engineering, physics, chemistry and from the glass factories.

It is obvious that a course combining all these subjects would be the ideal training for the glass technologist of the future. While it is a moot question what the saturation point is for glass technologists in the industry it is probable that it will not be reached for some time.

Glass Technology and the Trade Association

It is the place of the trade association to study the ways and means of promoting the use of glass. As new industries develop and expand new uses for glass are found and comprehensive surveys should be made and furnished to the membership.

Problems arise which face the entire industry and where it would be useless repetition of effort and wasted money for each member to solve the problem for himself. These problems seldom deal with glass technology. That is, they deal with the distribution and uses of the product rather than with its manufacture. It is the trade association which handles traffic problems, freight rates, standardization of packing, sizes, shapes, capacities and closures.

If an association maintains a laboratory, it should be run with the idea of studying the consumers problems in relation to the glass rather than the problems concerned with its manufacture.

The trade association should be in charge of campaigns for the education of the public and the consumer as to the proper way to handle glass and its limitations. When harmful propaganda is broadcast by competing industries it should be met by the trade association. It should likewise promote helpful legislation and fight unwise measures whose

result would be the substitution of foreign glass for American and be detrimental to American industry.

Generally speaking, a trade association should not do work that will be of benefit to one or two members only. Routine analysis of raw materials should be done in the members own control laboratory or by a consulting chemist and not in the laboratory of the association.

The attitude of the trade association should be broad and its policy should be so worked out that the public and the industry will be mutually benefited because of its existence.

The Consulting Chemist and Glass Technology

The consulting chemists throughout the country could very profitably have an association to maintain ethical standards in their dealings with each other, with the glass manufacturers and with the supply and equipment companies of which they are often agents.

It is these consulting chemists that serve the rank and file of the manufacturers that have no technical departments of their own.

A high standard of services should be maintained by these consultants. They should realize that their prestige and future prosperity comes from their satisfied customers. It may be that their progress in establishing confidence will come slowly but conscientious work and commensurate fees will accomplish this end.

Every glass consultant needs a laboratory where results may be obtained upon which his recommendations are based. Some men in this line are good guessers but one checked analysis is better than a dozen guesses.

When a glass house manager calls in a consulting chemist he gets no better service than the reputation of the consultant would justify him in assuming he would get. It is the man who promises everything that should be watched and avoided. These have been a few fly-by-night technologists working the glass houses in this country that have done a great deal of harm to the firms retaining them. In some cases outrageous and exorbitant profits have been extracted by these artists from sharp business deals with their clients.

It is not entirely just to condemn the practice of certain reputable consulting chemists in acting as agents for various raw materials or engineering equipment. In a way, these consultants are the best possible missionaries for the introduction of new materials for glass making or new glass house machinery. No one realizes better than the glass technologist the necessity for good homogeneous glass of the right composition and of the proper temperature to be delivered to a machine in sufficient quantity if the machine is to work satisfactorily. To obtain these conditions the technologist and the machine man must work very closely together. If one man can do both jobs, so much the better. It is only natural that sometimes an outsider might think that unneeded supplies and equipment had been recommended and installed but unless one knows all the facts in the case such an assertion may be doing an injustice. It is often impossible to foretell how experimental apparatus will work until it is tried.

Along this same line I wish to suggest that the practice of certain consulting firms (chemists) in branching out into the engineering field and the practice of engineering firms in branching out into the chemical consulting field seems to be a step in the right direction. These two branches of glass technology, glass house engineering and glass technology will eventually merge.

It is unfortunate that members of both of these groups have at times been accused of playing the part of tale-bearers from one glass firm to another. In some cases such accusations have been justified. When a glass chemist or a glass house engineer enters a factory he should regard what he sees and what he does in the light of a confidential relationship between him and his client.

Glass Technology and the American Ceramic Society

The American Ceramic Society offers to the glass technologist a unique medium for contact with other branches of ceramic science. At the annual meetings of the Society the glass man meets others engaged in varied lines of ceramic work. From these he gains much for they have many problems in common.

The *Journal* of the Society is the meeting place of those unable to attend the convention and it is there that the best papers are published and preserved. The abstracts of the current ceramic literature are helpful to a busy man unable to keep up with his collateral reading.

In the Glass Division of the A. C. S. we have glass technologists, university professors, chemists, physicists, factory managers, superintendents and salesmen of glass house equipment.

Papers are presented which deal with specialized parts of the field of glass technology. The chemists and physicists give papers which deal with the theoretical side of the subject and the factory men hear articles on their problems. Aside from the presentation of papers for the convention the Glass Division has done little. Even the papers have been given by a small minority of the membership. It would be a good thing if the Glass Division would make a rule that every member had to turn in a paper on glass at least once a year. With that number to select from the program committee would be able to give us a program worth while.

Nearly all the members of the Glass Division that are named on committees are too busy to do any real work and at the end of the year little progress has been made. It is almost essential in order to carry out an organized program of glass research that we have a skeleton organization or nucleus of men doing little else but work along that line. Such a group has been the mainstay of the Society of Glass Technology in England. The work of the Geophysical Laboratory on optical glass in this country or of W. E. S. Turner and his associates in England illustrate this point. One or more universities having departments of glass technology would be ideal neuclei for a successful Glass Division.

Even under present conditions the Glass Division could do some needful work on the standardization of the raw materials used in glass manufacture. This work has been started and will be continued. Also the methods of analysis will be standardized.

When industry takes full cognizance of the A. C. S. and

backs it up by sending plenty of their men to the conventions and instructs these men to give papers and take part in the discussions, we will have better meetings and better glass in the factories.

Among many firms there is the feeling that they have nothing to gain by belonging to the A. C. S. or by attending the meetings. I have had men tell me in all seriousness that they did not attend the meetings because no one there could tell them anything they did not already know and that they were afraid that if they went they might inadvertently tell some of their own secrets. This attitude was more common several years ago than it is now. It is significant that some of the firms employing these men have since failed.

For some reason we have always had a scarcity of glass plant executives present at these meetings. We have had plenty of executives present of firms that had something to sell us but too many of our own presidents, managers and superintendents were absent.

If the A. C. S. could get more of these men to come to our meetings and take part it would be the greatest thing for the Glass Division that could happen.

The Trade Paper

The trade paper contains the news pertaining to the glass industry. That is, it should contain new information for its readers or present old ideas from a new viewpoint.

From the glass technologists' standpoint the ideal trade journal will have a laboratory department where methods of analysis are given for raw materials and for the finished product. Together with this a consultation service could profitably be maintained where specific inquiries about glass and its problems may be answered.

It will have authoritative articles by recognized leaders in glass technology. These articles should be written in a more popular style than those in a journal read by scientists only. The scope of these articles should be broad, covering the fields of glass compositions, glass house engineering, machines, etc.

There will be a good patent department that will keep the readers in touch with the latest thought in glass manufacture as divulged by patents granted.

General news of the industry, trade activities, personals and raw material prices should have a reasonable amount of space. Lastly and by no means least, the trade journal should contain advertisements fully covering supplies and equipment used by the trade.

It is probable that a weekly paper will not be the best for this work. There is usually a paucity of material available for trade papers issued weekly and "padding" with hastily prepared and inaccurate articles is not a rare procedure. Articles written to "puff" the material sold by large advertisers, irrespective of their real merit, are often found and are easy to recognize.

If there is any criticism to be made of our present monthly trade papers it would be that they do not contain enough reading matter. Surely more detailed information could be given describing the progress of the work being done by the government bureaus, the trade associations and the universities. A department that would be much appreciated would be one where abstracts, reviews and criticisms of good articles in foreign publications on glass would be given considerable space. There is much valuable information that is not available to the American glass man because of his lack of time or ability to translate the articles for himself.

It would, perhaps, be hoping too much to want a trade journal that the average laboring man in a glass plant would read with interest but at least the paper should be such that every foreman in every glass factory in the country would want it and would subscribe for it. In order to be such a magazine the motto of the publishers should be "Every issue must contain something interesting and valuable to every glass plant foreman." When this goal has been reached the trade journals will be doing their full share to promote glass technology.

Some Tests on Bottle Glasses

In presenting a paper prepared by H. S. Blackmore and himself on "Some Tests on Bottle Glasses with the View to Prescribing Standards of Composition" at a recent meeting of the Society of Glass Technology in Manchester, England, Prof. W. E. S. Turner observed that it was desirable to fix upon a rapid test which could be applied under works conditions by a person not particularly expert. The present paper was an interim report on tests of 5 sets of bottles of different compositions. Three tests were employed.

(A) Boiling in the bottle a 0.1 per cent solution in pure water of narcotine hydrochlorine, and examining the solution every 2 or 3 minutes to ascertain if there was deposit of narcotine.

(B) Boiling the bottle for 6 hours and noting
(1) the amount of alkali extracted;
(2) the appearance of the bottle.

(C) Color test. A solution of $\frac{N}{5{,}000}$ H_2SO_4, with a colored indicator such as phenol red or bromothymol blue was added to the bottle and boiled.

In the case of bottles containing less than 8 per cent of lime, test A definitely picked out unsatisfactory bottles. In the case of the boiling water tests there appeared to be some differences in the results obtained. The importance of temperature in carrying out durability tests was emphasized, and it was remarked that individual bottles though treated in the same way appeared often to have characteristics of their own. Examination of the bottles after boiling for six hours was suggested as a rapid works test, those which were satisfactory developing no pitting, the unsatisfactory ones showing such pittings more or less extensively.

In another paper, "Some Experiments Upon the Development of Sillimanite Refractories for Glass," by W. Angus McIntyre, it was pointed out that careful selection of bond clay was necessary, the choice finally resting upon a Stourbridge old mine clay which developed a good crystalline bonding of secondary sillimanite after two hours firing at 1,420°. Specimens were immersed in soda-ash, salt-cake, potash-lead and fluorspar batches, and were seen to be much more resistant than ordinary tank blocks, fine grained sillimanite showing the best results. A selected mixture when made up into small pots for melting special soda-lime glass at temperatures of over 1,500°C showed very little signs of attack.

Fine Specimens of Modern Glass From Abroad

Exhibits Selected from the International Exposition of Modern Decorative and Industrial Art at Paris to Be Shown in Several Cities

An exceedingly interesting demonstration of the progress made in recent years by the master craftsmen of Europe in the design and production of art glass, both purely decorative and useful, was given during part of February and March at the Metropolitan Museum of Art, New York. The exhibit, comprised about 400 objects, including over 50 pieces of glass, which had been selected from the 1925 International Exposition of Modern Decorative and Industrial Art at Paris by Professor Charles B. Richards, director of the American Association of Museums and were brought to the United States by the association for exhibition at the Metropolitan and other museums of the country, with the object of giving industrial artists and the public an opportunity to see what other countries are doing to combine beauty with utility.

PAPER WEIGHT IN *PATE DE VERRE*.
Modelled by *Paul W. Bartlett*.

With few exceptions the articles have been lent by artists or manufacturers. Examples of modern furniture of distinctive design were plentiful and in some instances were shown *ensemble* with other furnishings. Rugs, lamps, bronzes, porcelains, pottery, mirrors, screens, paintings, lacquered ware, silver ware, ivory, decorative panels, books, wood cut prints, decorative iron work, wood carvings, silk brocades, cretonnes, velvets and numerous other products of modern industrial art were displayed.

This loan exhibition was arranged by Joseph Breck, curator of the Museum's Department of Decorative Arts, assisted by Miss C. L. Avery and P. Remington. Through the courtesy of Richard F. Bach, associate in Industrial Arts of the Metropolitan Museum, and his aide, Mrs. G. M. Palmer, photographs of the exhibits illustrated on the following pages were obtained.

The exhibits from Paris have already been shown in Boston as well as New York under the management of the American Association of Museums and are at present open to the public in Cleveland. From there the exhibit will be taken to Chicago, May 1 to June 4; Detroit, June 14 to July 10; St. Louis, July 19 to August 15; Minneapolis, August 23 to September 18; Pittsburgh, September 27 to October 23, and finally to Philadelphia, November 1 to 27.

The principal exhibitors of glass at the loan exhibition are listed below with comments on their work by the editors of the exhibition catalog. Figure numbers refer to the illustrations on the next two pages.

Daum Frères, Nancy, France

Glass vases decorated in enamel—white, red, yellow and blue. Glass bowl decorated in black enamel. (Fig. 8).

François Decorchemont

Cups and bowls *pâte de verre* in jade green, sea blue, marbled, and brown shell color. (Fig. 9).

During the last thirty years France has developed a veritable Renaissance in the making of decorative glass. Beginning with Gallé in the late nineties, with his exquisitely colored overlays, this Renaissance has produced techniques and effects of color and form never before compassed in the history of glass making.

Decorchemont and Dammouse have devoted themselves to the art of pâte de verre—glass paste worked at a heat just short of vitrifaction. In this art the former has achieved a remarkable series of translucent jade-like effects in bowls and vases of different colors which constitute a distinct contribution to the arts of decoration.

Marcel Goupy

Blue, green, orange and other glass vases decorated in blue, green, violet, and mauve enamel. (Fig. 7).

René Lalique, Paris, France

Glass vases and bowls *à cire perdue* decorated with flowers and apple blossoms, serpent and ram's head. Glass vases decorated with large berries, brown scarabs, birds. Glass vases in blue and gray, opal and in violet and opal green. Table water glasses. (Figs. 1, 5, 6, 11).

In 1900 the enamelled jewelry of René Lalique was one of the sensations of the Paris Exposition. The charming and highly novel quality of these creations added a new note to jewelry design. Since the World War Lalique has turned almost his entire attention to the art of decorative glass and in this field his prolific genius has evolved a great variety of exquisite effects in form and color hitherto unknown to the glass maker. He has also produced a number of interesting designs for table glass which sells at very moderate figures.

J. & L. Lobmeyr, Vienna and Carlsbad

Engraved crystal vases, pocale, fruit bowl, scent bottle, wine glasses. (Fig. 3).

In Central Europe the art of engraving on glass was carried to great elaboration in the seventeenth and eighteenth centuries and in two places, Vienna and Orrefors, there has been of late years a remarkable modern revival.

The firm of J. & L. Lobmeyr have employed the foremost artists available in central Europe to design the forms and decoration of their products and have brought to their execution the highest type of technical skill.

Maurice Marinot, Troyes, France

Glass vase decorated in white enamel. Glass bottles engraved. Glass bottles and bowl showing air bubbles. Glass bottle decorated in red enamel. (Fig. 2).

Marinot is often referred to by his countrymen as possessing the greatest artistic genius of any of the workers in glass.

Orrefors Bruks Aktiebolag, Orrefors, Sweden

Engraved glass bowls, bottle, and pocale, designed by Simon Gate and Edward Hald. (Figs. 10, 12).

At Orrefors occurs the second notable development of the art of engraved glass.

The exquisite engravings upon the vases and cups and bowls produced by this firm are due principally to two artists, Simon Gate and Edward Hald, the first inclined to the classic in treatment and the second to more picturesque plays of fancy.

A. Walter, Nancy, France

Vases and cups in green and blue, yellow, pale orange, rose, and white, *pâte de verre*. Paper weight in *pâte de verre*. (Fig. 4).

FIG. 1. BLACK GLASS VASE WITH BIRD DECORATION.
René Lalique, Paris.

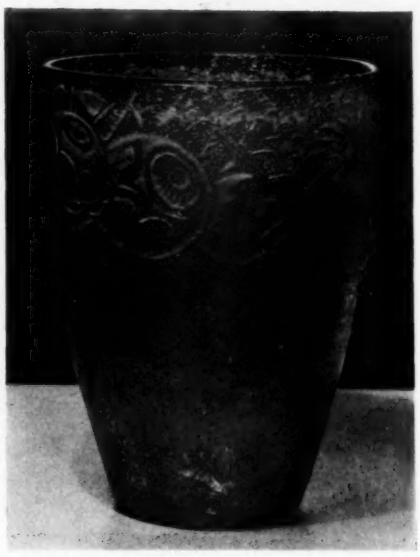


FIG. 2. GLASS VASE DECORATED IN WHITE ENAMEL.
Maurice Marinot, Troyes.

FIG. 3. ENGRAVED CRYSTAL VASE, "BACCHUS AND ARIADNE."
Designed by Lotta Fink.—*J. & L. Lobmyer, Vienna.*

FIG. 4. CUP IN YELLOW *PATE DE VERRE*, WITH GREEN FOOT.
Modelled by Gauvenet.—*A. Walter, Nancy.*

FIG. 5. GLASS VASE DECORATED WITH BROWN SCARABS.
René Lalique, Paris.

FIG. 6. GLASS VASE *A CIRE PERDUE*, DECORATED WITH SERPENT AND RAM'S HEAD.
René Lalique, Paris.

FIG. 7. ORANGE GLASS VASE, DECORATED WITH MAUVE FLOWERS AND GREEN LEAVES IN ENAMEL.
Marcel Goupy

SPECIMENS OF MODERN GLASS from the International Exposition of Decorative and Industrial Arts. Exhibited at the Metropolitan Museum of Art, New York, under the management of the American Association of Museums.
(See page 85)
Photographs by courtesy of Metropolitan Museum of Art.

FIG. 9. CUP OF JADE COLORED *PATE DE VERRE*, DECORATED WITH OLIVES AND CHRYSANTHEMUMS.
François Decorchement.

FIG. 11. GLASS VASE DECORATED WITH LARGE BERRIES.
René Lalique, Paris.

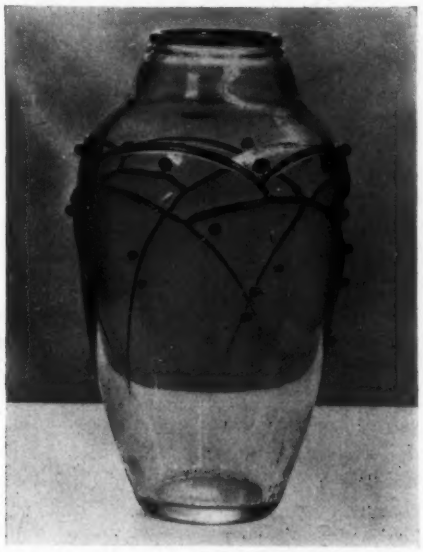


FIG. 8. GLASS VASE DECORATED WITH BERRIES IN RED ENAMEL.
Daum Frères, Nancy.

FIG. 10. ENGRAVED GLASS BOWL.
Designed by Simon Gate. *Orrefors, Sweden.*

FIG. 12. ENGRAVED GLASS BOWL.
Designed by Simon Gate. *Orrefors, Sweden.*

Heat Transfer in Glass Furnaces

Abstract of a Paper Read at the Annual Meeting of the American Ceramic Society, Atlanta, February 10, 1926

By D. J. McSwiney*

It is a rather general belief that heat transfer in medium high temperature furnaces, such as a bottle or flat glass furnace, is effected almost entirely through radiation. However, many of the phenomena of glass furnace operation cannot be fully explained by the assumption that heat transfer in furnaces is effected entirely through radiation. As the problem of improving furnace operation is one of great importance, it may be of interest to review briefly some of the laws of heat transfer.

The rate of heat output by radiation from a body per unit of surface depends, first on the nature of the body and, second on its absolute temperature. The rate of heat transfer between two bodies depends on the nature and size of the bodies, on the temperature differential between them and on the method of heat transfer. The heat transferred by conduction through direct contact is directly proportional to the temperature differential. The heat transferred by radiation, however, is proportional to the fourth power of the absolute temperatures of the bodies. Because the rate of heat transfer by radiation increases very rapidly with increase in temperature, rapid transfer of heat can take place at high temperatures even when the temperature differential between the radiating bodies is small.

Tanks melting soda lime glasses are operated at temperatures between 2,350 and 2,650 deg. F. The temperature of the glass surface is usually about 2,500 deg. F. The heating is effected by tongues of flame from one to six in number, that pass crosswise or longitudinally through the furnace. These flames differ greatly in shape and size, in temperature and luminosity, and in their distance from the walls and bath. In some cases they flow parallel to the bath, while in other cases they impinge on it.

Glass furnaces differ widely in their thermal efficiency. Considering the wide variations which exist in their construction and operation, the actual variation in the efficiency of heat transfer is comparatively small.

Great rapidity of combustion is not always desirable because of its destructive action on the refractories. It is often stated that the best fuel is that which gives the highest temperature. This, however, is not necessarily the case with glass furnaces.

In fact, with some fuels, the best operation is secured when the actual flame temperature is much lower than that theoretically obtainable. The flame temperature depends not only on the character of the fuel but also on the rate of combustion.

The main factor in determining the rate of combustion of any fuel is the intimacy of the mixing of the incoming air and combustible. In some glass furnaces intimate premixing of the gas and air does not take place and the rate of combustion is not as rapid as it might be. The flame temperature obtained is consequently much lower than that theoretically obtainable with the fuel used.

The intensity of radiation from any source varies as the square of the distance from the source. As the distance from the flames to the walls and bath shows wide variations in different furnaces, it would appear that the intensity of radiation would show some differences in these different furnaces, but, as a rule, little or no such differences are evident. This is largely due to the fact that cross radiation within the furnace tends to equalize the furnace temperature, so that, if any part of the furnace receives from the flame more heat than some other part so as to acquire a much higher temperature, rapid radiation between the two parts tends to bring them to the same temperature. As the flame passes through the furnace it drops in temperature, the average temperature differential between the furnace and the source of heat being much greater in that part of the furnace where the combustible enters and near where most of the combustion takes place, than it is in that part where the waste gas leaves the furnace and where little or no combustible is present. Accordingly, the temperature of the first part of the furnace tends to and would be much higher than that of the second part were it not for the equalizing action of cross radiation.

There are, however, some things which can not be entirely accounted for by cross radiation. The working parts of a furnace may be from 10 to 25 feet from the nearest flame and, in those having a high bridge wall, no direct radiation from the flame to the working end is possible and also radiation from the walls and bath in the melter cannot be great.

The factor which influences heat distribution between the melter and the refiner to the greatest extent, is not the character of the flame in the melter but the furnace pressure maintained.

An increase in the stack draft caused by decreasing the furnace pressure, quickly lowers the refiner temperature, even if the furnace pressure is still maintained sufficiently high to prevent much cooling air being drawn in through the working openings.

The radiating power of flames influences the amount of heat transfer but the temperature of the flames does not necessarily affect the heat transfer.

The radiating power of a carbon monoxide flame is two and a half times that of a hydrogen flame. Producer gas very high in hydrogen sometimes gives poor results but high hydrogen gas often means gas of a high moisture content. Moisture in producer gas does not show in the ordinary analysis, yet the moisture is one of the most variable of the constituents of producer gas, and at times it is higher than any other constituent, except nitrogen.

It is usually assumed that the luminosity of a flame is

*Consulting chemist, Columbus, O.

due to the presence of incandescent solid particles. The difference between the luminous and non-luminous flames in the furnace then, may be largely due to a difference on the extent of completeness of combustion.

The heat set free by the combustion of the fuel cannot be dissipated as quickly as it is formed, so that the non-luminous products of combustion must necessarily retain a large portion of this heat. That the radiating power of non-luminous gases must be very low is shown by their slight effect on the radiation pyrometer. Such a pyrometer sighted on the wall of the furnace through a visible flame will give a high reading, but when sighted through a tank full of non-luminous gases their effect on the pyrometer is usually not noticeable.

The possibility of flame circulation in the furnace being an important factor in heat transfer in glass furnaces, should not be disregarded, as it is actually the main factor of heat transfer in low temperature furnaces. Flame circulation can aid heat transfer indirectly by causing the hot gases to remain in the furnaces much longer than they would if they followed a direct channel through the furnace.

The factor which influences the rate of heat transfer by contact, to the greatest extent, is the velocity of flame of the gases. Turbulent flow prevents formation of insulating layers of air and constantly furnishes a fresh supply of hot gases to the surface of the walls.

The momentum of the inflowing stream of fuel is not the only factor present in the furnace which will tend to induce rapid circulation. The combustion of the gases should help to induce rapid circulation as they burn with almost explosive like rapidity causing a considerable increase in volume during combustion and subsequent contraction due to the cooling of the gases, like the opening and closing of a bellows on the air surrounding it. Combustion through heat transfer from the waste gases should greatly promote circulation. The flow of waste gases induced by the stack draft and the conflicting currents promoted by the cooling of hot gas in contact with the walls and crown should also promote circulation.

It is suggested that circulation of the hot gases in glass furnaces may be an important factor in the transfer of heat to the furnace and its contents, especially from hot burned gases of low radiating power. This factor should be given consideration in changes in construction and operation made for the purpose of improving heat transfer.

The Design of Arches for Kilns and Furnaces*

By F. H. NORTON, East Liverpool, O.

The stresses in arches are considered in such a way as to indicate the forms of arch giving a minimum of static and temperature stresses. It was found that the most satisfactory arch had a rather high ratio of rise to span which led to instability in the circular arch. However, by using an arch in the form of an inverted catenary, the advantages of the high arch can be retained together with stability.

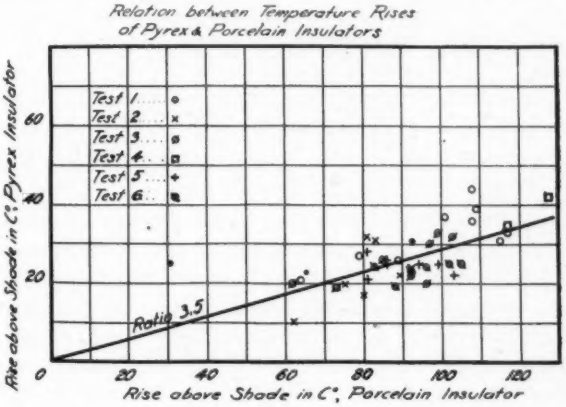
The various properties of the catenary are discussed and equations are given for computing any characteristics. Some actual examples are worked out to show the use of hyperbolic functions in designing catenary arches.

*Abstracts of papers presented at the annual meeting of the American Ceramic Society at Atlanta, Ga., Feb. 10, 1926.

Relative Temperature of Pyrex Glass and Porcelain in Sunlight*

By J. T. LITTLETON, JR., Corning, N. Y.

A series of temperature measurements were made on Pyrex glass insulators and porcelain insulators in sunlight. The insulators were placed at the focal point of a large sheet iron reflector, designed to give a considerable amount of spherical aberration. Thermocouple wires were cemented to various points of the insulators and the average steady temperature



obtained by the insulators was noted. The curve between the rise of temperature of the porcelain insulator above atmospheric temperature and the rise of Pyrex glass insulator above this point was plotted. The experiments show that the temperature of the porcelain insulator increases about three and a half times as much as one made of Pyrex glass, exposed under the same conditions.

Drawing Room Practice to Be Standardized

The American Engineering Standards Committee announces the launching of a comprehensive program of standardization of drafting room practice. This action follows the unanimous recommendations of a representative conference held in December, which was attended by fifty individuals, representing a total of forty-eight professional and trade associations, large engineering schools, and manufacturing concerns, particularly interested in drawings for shop and construction work.

Doing away with the diversity in drafting room practice will result in a more ready understanding of drawings.

Besides the question of sizes of drawings, the program adopted by the conference contains mainly the following items: Classification of and corresponding nomenclature for drawings in accordance with their purpose; method of representation of the subject, as, for example, the arrangement of views and sections; indication of dimensions and tolerances, indication of surface or finish; symbols representing in a diagrammatical form certain elements of construction, as threaded parts, gears, etc.; the arrangement of drawings as to borderline, title, notes; indication of changes and revisions, method of folding, etc.; the kind and size of lettering, figures and symbols; scales of reduction or enlargement; sizes of filing cabinets; drafting equipment and tools (triangles, scales, etc.); specifications for materials to be used for drawings (paper, tracing cloth, inks, pencils, etc.).

A New Method of Producing Colored Glass

Corning Glass Works Obtains Patent Covering Important Discovery

The Corning Glass Works of Corning, New York, has recently obtained a patent[1] covering an invention of considerable interest. It is based on the discovery that the addition of certain alkali metal halides (i.e., the alkali metal fluorides, chlorides, bromides and iodides) or the halogen salts of other elements to a glass batch containing coloring oxides or salts will effect modifications in the color produced usually in the resultant glass. Many different colors may be obtained by varying the ratio of the halide salt to the metallic oxide or salt used to produce the color, or by varying the ratio existing between the alkali salts, silica and boric oxide contents of a boro-silicate glass.

Effects Most Notable in High Boron Glasses

The effects of such halide salts are most noticeable with glasses containing a very high percentage of boric oxide, where cobalt is used as the coloring agent, and where some salt of chlorine is used to produce the color change. Glasses low in boric oxide do not show this property to the same degree, but the effect of the halide salts is not confined to borosilicate glasses. Phosphate glasses are quite noticeably affected by the halides.

Less effect is noted if a bromine salt is used and still less if salts of fluorine or iodine are used to replace the salts of chlorine. For this reason the use of chlorine or bromine salts is especially recommended.

If coloring agents other than cobalt oxide or nickel oxide are used with halogen salts in borosilicate glasses, the changes in color are less marked, but most coloring materials in such glasses are affected to some extent by the halogens.

The color due to oxide of nickel is noticeable in the amount of change produced. The yellow color due to nickel oxide in a high boric oxide glass is converted to a violet color by the use of chloride salts. Other coloring agents such as manganese dioxide, iron oxide, copper oxide, chromium oxide, vanadium oxide, neodymium oxide and uranium oxide seem to be less modified by the halides.

Effect of Halogen Salts Reverse of That of Boric Oxide

In general the effect of increasing the percentage of boric oxide in glasses colored by various metallic salts is to cause decreased absorption at the red end of the spectrum, namely, in the red and yellow. The blue purple produced by cobalt oxide is modified to red purple. The red purple due to nickel oxide is modified to amber, the red purple produced by the action of manganese is changed to amber, the blue green copper oxide color is modified to a yellow green by the addition of large amounts of boric oxide. The addition of halogen salts not only reverses this effect, but in the case of cobalt and chloride salts the reversal is even carried beyond the color of the glass free of boric oxide, so that in such glasses a better blue and in some cases green transmission can be obtained for a given red absorption than is the case in glasses free from boric oxide.

It is a matter of common knowledge that a good blue cannot be obtained with cobalt oxide alone. Even in potassium silicate glass, which are the most favorable for this purpose, the cobalt alone gives a blue transmitting enough red to be called purple. By this invention, however, it is possible to produce blue and even in extreme types of glasses to produce a distinct green without any coloring oxide other than cobalt.

The use of alkali chloride in borosilicate glasses containing cobalt oxide illustrates the most striking feature of this discovery. The color changes are dependent on several factors, namely, the ratio of alkali to boric oxide, to silica; the percentage of cobalt oxide, the percentage of chloride added to the batch and the percentage of chloride retained in the glass, and the percentage of other constituents. Either of the alkali metals, potassium, sodium or lithium may be used.

In general the higher the percentage of boric oxide present the more extremely red the color produced by cobalt, and the more inclined to green when cobalt and chloride are both present. Although boric oxide seems to be the factor of most influence, the per cent of alkali is also important, in general the better red absorption being produced when alkali is high, although the extreme color change produced by chlorides may not be as great. The effect of adding other oxides to the alkali borosilicates tends to nullify the effect of chlorides. This does not hold true, however, for alumina or for small amounts of arsenic oxide. Barium salts have only a slight effect, but lead, lime, magnesia, zinc, antimony, phosphorus and zirconium salts are all more or less injurious to the effect of chlorides as are also most of the coloring oxides. This holds true in the case of cobalt itself, changes produced by chlorides being most marked the lower the percentage of cobalt. The higher the percentage of chloride the more marked the effect.

The following batch formulæ illustrate this invention:

	Silica SiO_2	Boric oxide B_2O_3	Alkali as potash K_2O	Alumina Al_2O_3	Cobalt oxide Co_2O_3	Nickel oxide NiO	Alkali as soda Na_2O
1	15	80	..	..	.1	..	5
2	47	39	11	3	.1	..	..
3	47	39	11	3	..	.1	..
4	47	39	11	3	.2	..	..
5	66	32	2	..	.2	..	..
6	55	31	14	..	.1	..	..
7	55	31	14	..	..	.1	..
8	68	24	8	..	.2	..	..
9	76	19	5	..	.2	..	..
10	70	12	18	..	.1	..	..
11	65	23	7	5	.3	..	..
12	65	23	7	5	..	.1	..

In the above formulæ soda (Na_2O) and sodium chloride may be substituted for potash (K_2O) and potassium chloride in molecular percentages respectively without affecting the described colors. Lithia (Li_2O) and lithium chloride may be also substituted for potash and potassium chloride, but with not quite as effective results.

By adding 97 parts of batches of the above formulæ to 3 parts of potassium chloride and melting, glasses will be pro-

[1] U. S. Patent No. 1,572,625. Feb. 9, 1926.

duced having in plates 6 mm. thick, when viewed by transparent light from a tungsten filament lamp, the following colors as contrasted with the colors of such glass without the chloride.

	Color with KCl added	Color without KCl
1	Green.	Red.
2	Green.	Red.
3	Indigo.	Lemon yellow.
4	Blue green.	Red.
5	Blue.	Red inclined to purple.
6	Blue.	Red purple.
7	Violet.	Yellow.
8	Blue.	Red purple.
9	Blue purple.	Red purple.
10	Blue.	Blue purple.
11	Blue.	Red purple.
12	Amber.	Amber.

The inventor, William Chittenden Taylor, specifies the following claims:

1. A process of modifying the colors due to metallic salts in borate glasses by adding a halogen.

2. A glass containing silica, alumina, boric oxide, a halogen and a metallic coloring element, the normal color of whose oxide is modified by the halogen.

3. A glass batch containing silica, alumina, boric oxide, a halogen containing substance and a metallic salt, the normal color of whose oxide is modified by the halogen.

4. A process of modifying in glasses the colors due to cobalt-oxide, which comprises adding a substance containing a halogen whose atomic weight is over 20 and under 80.

5. A process of modifying in borate glasses the colors due to cobalt-oxide, which comprises adding a substance containing a halogen.

6. A process of modifying in glasses the colors due to cobalt-oxide by adding a substance containing chlorine.

7. Modifying in borate glasses the colors due to the cobalt-oxide, by adding a substance containing chlorine.

8. A glass batch containing silica, alkali, boric-oxide, a salt of cobalt and an alkali-metal chloride.

9. A process of modifying the colors due to a salt of an element of the eight periodic group having an atomic weight between 58 and 59, which comprises adding a substance containing a halogen whose atomic weight is over twenty and under eighty.

10. A glass containing silica, alkali, boric oxide, a halogen whose atomic weight is over twenty and under eighty, and a salt of an element of the eighth periodic group having an atomic weight between 58 and 59.

A Classified List of German Patents on Glass

T. E. Kirch *

While making a search recently in the United States, British and German patents the writer was impressed by the number of apparently valuable patents on the subject of glass in the German, which were not to be found in the other two lists. In order to aid those not familiar with the language or with this special line of work, a classified list of the German patents dealing with the subject of glass was prepared.

The excellence of the work done by the Germans in all phases of the industry in the past half century, especially in the development of special glasses for special purposes, and melting and annealing furnaces is well known. In only one branch do the honors go to another country and that is in the development of automatic machinery, which honors come to us without competitors. Therefore, the contents of the following listed patents ought to be of considerable value to the glass industry of this country.

The arrangement is according to the "Manual of Classification of German Patents" as issued by the United States Patent Office, 1911. To find the patents on any special line it is only necessary to find the proper sub-class which covers this branch. For instance, Pot Furnaces and Pots, is found to be Group 32a, sub-group 2 in the classification. All the numbers in this group deal only with this limited phase of the general subject. The numbers can be examined in the "Auszüge" (Abstracts), or in the original specifications. The Scientific Library of the United States Patent Office has them on file as well as a number of libraries in the larger cities. The specifications can be obtained from the German Patent Office, Berlin, for one "Goldmark" each (approximately $0.24 at this date).

This list has been carefully prepared and checked. It is complete as far as possible to make it with the following exceptions. The last half volume of "Auszüge" for the year 1919, and 1920, numbers 21, 32, 33, 34 were missing from files from which this was taken. They may contain patents pertaining to glass. We should be glad to know if they do.

Index to List of German Patents

Those who have searched for a specific patent number in the "Auszüge" of the German patents know how difficult it is to find. In order to make this work somewhat easier the index on the following page was developed. It has been published elsewhere twice to my knowledge covering the period up to the beginning of the war, 1914. The information was obtained from the Technology Department of the Carnegie Library of Pittsbugh whose staff originally prepared the data.

It had never brought up to date because there are no complete collections of German patents in the country due to some of the catastrophes of the recent war. The necessary information to complete this index was received from friends in Germany recently.

The following is the method I use to locate patents in the "Auszüge." Find the year when the patent was issued in the following Index. Go to the "Verzeichnis" for that year. The key in the front will give the group number in small type. Further back will be found the page number of the "Auszüge" for that year on which the patent can be found, under this group number.

* Engineering Department, The Nivison-Weiskopf Co., Reading, O.

Index to "Verzeichnis" of German Patents

Patent number	Year	Patent number	Year
1- 4,390	1877-78	128,483-139,092	1902
4,391- 8,800	1879	139,093-149,056	1903
8,801- 12,766	1880	149,057-158,245	1904
12,767- 17,105	1881	158,246-167,845	1905
17,106- 21,236	1882	167,846-181,275	1906
21,237- 26,084	1883	181,276-194,525	1907
26,085- 30,543	1884	194,526-206,135	1908
30,544- 34,561	1885	206,136-218,130	1909
34,562- 38,569	1886	218,131-230,230	1910
38,570- 42,451	1887	230,231-242,870	1911
42,452- 46,374	1888	242,871-255,950	1912
46,375- 50,780	1889	255,951-269,470	1913
50,781- 55,460	1890	269,471-281,820	1914
55,461- 61,010	1891	281,821-290,010	1915
61,011- 66,910	1892	290,011-296,281	1916
66,911- 73,340	1893	296,282-303,680	1917
73,341- 79,620	1894	303,681-311,090	1918
79,621- 85,340	1895	311,091-318,790	1919
85,341- 90,750	1896	318,791-333,470	1920
90,751- 96,190	1897	333,471-348,890	1921
96,191-101,760	1898	348,891-369,600	1922
101,761-109,190	1899	369,601-390,120	1923
109,191-117,974	1900	390,121-408,310	1924
117,975-128,482	1901		

German Patents—Class 32—Glass

32a. Manufacturing, e.g., Fusing, Clearing, Pouring and Measuring; Molding, e.g., Blowing, Pressing, Drawing, Rolling and Making Wire Glass; also Finishing Operations, as Cooling, Hardening, Flattening, Reheating and Opening Up Cylinders.

Manufacture of Glass by Fusion of the Raw Materials. (Groups 1-6.)

1. Tank furnaces

6,902	12,920	14,617	19,028	19,820	20,952	22,273
22,736	24,638	29,770	34,317	38,658	45,063	69,687
76,473	82,304	85,569	87,311	87,312	92,242	109,357
138,860	203,761	224,070	244,467	245,102	251,249	252,393
281,416	288,778	314,605	322,776	362,776		

2. Pot furnaces and pots.

3,647	6,747	9,518	13,608	14,599	20,840	21,109
22,087	22,089	29,703	36,117	51,356	70,233	73,934
84,234	93,598	115,636	116,943	122,239	124,699	164,441
176,750	178,578	184,284	186,227	195,145	201,190	202,435
215,448	221,981	227,445	236,209	251,357	288,945	289,827
290,804	295,933	322,707	325,251	335,676	340,918	344,636
347,832	392,354					

3. Combined tank and pot furnace.

51,962	53,733	68,774	102,674	112,290	189,962

4. Other glass fusing furnaces exclusive of groups 1 to 3, especially cupola furnaces and electric furnaces. (Appliances for electric glass fusing furnaces not peculiar to glass making, 21 h, 6-11.)

8,387	11,728	17,736	20,226	27,719	31,935	101,176
120,842	124,702	128,250	131,291	134,935	137,334	138,416
151,657	167,023	217,422	236,010	237,100	281,984	369,906

5. Auxiliary apparatus for use in glass fusing, exclusive of group 6, e.g., tap holes, clearing and charging apparatus.

925	2,955	6,161	11,001	12,922	15,153	20,185
26,846	51,886	61,042	61,375	67,505	71,828	73,282
79,402	112,896	116,318	127,931	138,439	139,336	155,051
159,314	167,396	174,748	175,223	177,180	181,532	182,088
185,766	188,792	188,783	191,158	192,250	194,260	198,959
205,607	212,847	226,810	235,887	264,692	270,012	276,205
277,342	280,283	300,095	302,571	303,263	303,264	303,706
303,993	306,308	313,477	323,674	343,827	373,750	390,402
391,240						

6. Pouring and measuring apparatus for molten glass provided it forms part of the melting furnace.

12,929	16,481	26,674	112,589	116,134	134,798	140,227
158,970	165,661	264,051	284,516	370,987	370,988	382,725
395,448	392,910					

First Manipulation of Glass from the Fused Condition. (Groups 7-24.)

7. Mouth glass blowing in general. (cf. group 8 and group 10.)

2,249	3,308	6,316	8,096	9,639	15,937	23,855
61,164	64,408	65,591	80,743	86,541	96,466	101,130
108,905	109,196	109,857	114,291	118,248	126,111	127,932
128,829	132,711	132,715	135,421	138,231	148,217	148,853
154,610	156,963	158,449	174,714	175,868	178,695	185,657
187,410	241,531	241,532	250,308	267,528	277,343	277,442
338,086	345,978	360,339	369,440	397,426		

8. Mouth glass blowing for making special forms of objects. (Blowing glass letter, group 8.)

1,309	2,999	9,667	11,503	24,378	30,967	42,569
45,979	52,738	56,283	61,151	61,676	70,231	70,588
76,024	77,792	84,506	86,152	89,116	93,855	97,424
105,922	108,897	109,109	116,133	124,706	139,337	140,930
161,314	176,514	189,362	192,122	193,419	199,299	199,983
199,984	211,841	252,880	261,109	266,213	287,384	287,939
291,407	291,785	292,662	295,619	330,286	349,862	363,384
375,239	389,478	394,752	401,592			

9. Compressed air glass blowing for the purpose of finishing a blank formed by hand on the blowing iron. (cf. group 10.)

10,873	28,646	40,346	42,230	46,704	52,665	57,580
89,117	90,909	91,512	93,000	98,548	101,998	101,999
102,000	102,001	102,367	102,753	103,052	103,514	105,921
115,809	120,423	126,251	129,583	129,634	133,602	134,793
136,199	140,693	191,841	193,416	195,722	236,620	242,089
249,419	253,514	263,917	266,358	287,479	290,400	290,988
360,898	379,244	379,339				

10. Swinging apparatus for plate glass blowing. (Compressed air or mouth blowing.)

72,122	77,814	92,312	99,150	184,047	265,542	343,606
343,828	401,596					

11. Sievert glass blowing process and combinations of the same with other glass-forming processes in one operation.

109,363	109,365	111,393	111,882	112,248	113,235	115,606
115,635	116,026	116,135	116,682	117,936	118,246	124,704
128,016	128,251	137,360	137,361	154,888	156,584	156,585
157,847	174,256	187,651	193,415	199,275	218,446	234,344
238,280						

12. Compressed air glass blowing in casting and blowing machines with a casting core. (The neck opening of the bottle blank being formed by pressing or casting over a movable or fixed core.)

54,912	58,961	63,540	69,551	72,734	77,728	85,810
86,877	90,882	105,842	108,518	111,073	113,869	120,276
120,902	125,336	126,052	127,298	134,796	136,530	136,648
136,895	138,859	139,446	142,625	142,802	144,376	148,892
151,628	156,964	161,344	161,557	164,440	165,832	174,792
176,959	185,052	208,031	211,077	213,466	222,132	223,317
227,868	230,944	234,384	235,179	235,847	236,909	241,750
245,989	250,278	250,307	253,315	254,867	256,816	258,997
262,892	263,920	268,893	272,701	272,938	277,469	280,008
281,306	283,203	284,547	284,211	286,298	286,673	290,798
292,167	297,407	330,979	350,251	362,998	396,548	

13. Compressed air glass blowing in casting and blowing machines with an inserted core (the neck opening of the bottle blank being formed by the forcing in a core), also with a casting core and inserted mandrel.

47,570	52,208	61,149	70,888	109,068	113,798	114,224
114,225	114,292	114,867	116,027	116,927	123,657	124,707
127,844	132,137	133,942	134,439	164,439	183,524	183,525
221,665	230,999	269,949	270,013	279,147	291,778	315,996
322,050	322,955	325,087	338,322	340,677	343,535	363,946
395,449						

14. Compressed air glass blowing in pressing and blowing machines (the hollow bottle blank, the bottom of which is not materially thicker than the walls, being formed by pressing).

52,841	53,331	63,731	63,849	66,918	90,216	102,845
129,211	129,336	134,795	142,259	142,520	143,171	150,960
157,520	168,996	176,093	176,511	179,569	193,417	193,418
194,096	196,282	200,540	218,834	219,688	234,546	256,502
261,888	277,013	294,399	299,566			

15. Elements of compressed air glass blowing apparatus of groups 12 to 14 (particularly for the production of special forms of objects).

64,498	114,815	142,521	143,005	146,269	148,543	152,635
153,963	154,417	158,225	160,285	161,831	162,210	162,294
164,523	165,833	167,312	167,858	172,122	174,510	175,133
176,508	176,509	178,311	179,647	182,204	182,400	183,066
187,091	187,599	192,684	193,939	198,554	199,595	206,252
210,027	214,175	215,711	216,533	223,074	226,546	231,858
232,286	233,128	237,063	241,261	244,009	245,945	246,178
247,550	261,889	262,891	266,212	266,800	269,126	271,132
273,473	274,646	274,858	277,813	277,873	277,912	281,986
282,069	283,547	284,517	284,546	284,649	289,564	292,226
292,318	292,319	292,663	292,853	293,885	294,220	294,400
296,486	296,820	320,786	322,170	322,317	325,004	325,088
326,003	329,532	330,980	331,629	332,070	343,604	343,605
348,946	362,999	376,207	388,201	389,155	390,675	390,676

16. Glass pressing in general. (cf. groups 17, 18, and 22.)

20,985	34,137	38,764	38,906	42,892	46,464	50,497
50,634	70,488	71,671	73,879	78,658	82,472	84,433
85,303	99,231	108,450	109,647	111,215	132,324	188,781
190,806	211,842	236,910	336,069	399,636	401,594	

17. Pressing glass to produce special forms of objects. (cf. groups 18 and 22.)

22,484	23,655	24,802	27,048	31,582	32,481	48,943
52,921	57,693	57,968	58,078	61,365	62,467	64,185
65,491	70,018	72,967	75,519	77,789	82,004	85,495
87,733	91,824	97,850	100,334	112,250	124,700	134,342
139,550	148,365	160,888	160,889	167,113	170,305	179,818
180,091	180,433	187,408	202,436	204,436	209,924	212,620
220,555	247,374	277,722	288,807	313,572	313,627	317,642
319,862	347,998	368,047	374,867	397,427		

18. Pressing and otherwise forming tiles and glass letters, not including stamping. (cf. group 23).

61,048	86,973	93,226	99,166	100,920	103,933	108,808
111,472	111,996	134,797	169,956	180,535	197,966	210,474

19. Rolling plate glass from the molten glass without special designs (also pressing molten glass through shaping apertures). (cf. group 24.)

38,662	42,036	48,936	49,538	53,665	65,589	66,919
76,027	80,285	87,259	100,557	103,442	106,084	108,807
108,809	109,858	122,812	139,712	141,143	143,389	148,216
149,615	150,700	159,628	172,064	172,123	188,974	201,081
210,026	212,859	223,318	226,811	232,670	245,944	247,280
260,071	281,366	281,404	295,551	332,303	334,699	339,502
391,700	392,355	398,887				

20. Rolling plate glass with special designs, and rolling articles other than tubular form from molten glass, exclusive of groups 18 and 22.

35,848	70,228	71,563	82,131	111,216	111,470	111,471
114,290	134,936	136,398	153,046	192,758	195,229	223,379
226,545	260,023	300,304				

21. Auxiliary apparatus for glass rolling, e. g., plate supports (cf. 81e, 34), pot tongs, and other apparatus for moving pots (cf. 35b, 1).

40,718	118,247	138,861	246,126	250,210	255,744	268,109
334,842	338,687					

22. Rolling and other forms of wire glass or asbestos glass from molten glass; also rolling plate glass with the application or insertion of granular materials.

46,278	60,560	65,568	78,174	79,256	81,426	82,609
83,081	86,074	89,438	89,699	98,033	98,846	102,961
103,515	105,516	106,078	107,788	110,235	110,236	113,171
117,237	122,726	123,131	124,705	128,767	133,742	139,910
141,360	149,509	155,704	163,190	164,360	167,435	172,835
176,513	180,164	184,048	198,555	221,309	224,918	239,879
240,723	275,019	336,298	360,777	363,218		

23. Stamping softened glass (perforating apparatus, apparatus for forming fluted edges). (cf. group 27.)

25,529	67,292	71,635	78,738	81,096	86,483	91,287
104,322	109,110	249,555	380,947			

24. First treatment of glass from the fused condition in other ways than those mentioned in groups 7 to 23, e.g., by centrifugal action, by shaking, by allowing the glass to flow through shaping apertures, by drawing, pulling out or allowing the glass to sink down. (cf. group 19.)

34,724	36,214	44,517	45,584	51,682	51,887	53,121
56,664	68,317	68,590	68,601	69,091	70,761	71,514
79,928	80,344	86,073	92,656	92,657	95,812	101,335
104,435	106,768	107,587	117,935	147,366	147,367	156,586
157,210	160,284	161,279	161,465	162,582	164,442	165,449
166,533	166,566	169,955	170,824	171,055	171,056	173,205
177,959	177,960	178,579	178,580	182,829	184,909	185,765
185,839	187,845	188,285	190,805	191,491	193,776	194,413
196,026	196,028	197,422	205,552	206,221	206,546	206,547
208,264	208,265	209,925	210,475	210,476	213,859	216,602
219,320	219,652	220,036	224,036	227,109	227,339	227,830
230,145	231,058	232,136	233,943	238,996	240,913	241,480
242,124	246,392	246,483	247,157	252,181	253,890	257,775
261,108	264,167	267,586	267,204	272,441	272,442	274,226
275,457	276,206	281,985	288,589	289,919	290,114	290,401
324,809	332,071	334,700	338,831	339,756	341,465	345,979
362,160	368,357	368,358	377,231	379,851	384,139	384,589
384,796	388,948	389,479	389,522	390,947	391,558	391,559
394,325	396,355					

Subsequent Treatment of Glass Articles Under the Influence of Heat. (Groups 25-27.)

25. Glass molding tongs with exterior or interior movable forms for molding bottle mouths.

386	12,602	14,469	25,510	30,804	33,005	33,396
34,590	36,463	38,181	44,619	45,062	45,968	51,275
53,116	56,261	56,674	57,688	57,969	91,144	94,404
94,505	95,760	97,717	105,679	105,889	112,251	113,172
115,578	119,287	139,840	140,581	157,730	176,749	212,752
392,561						

26. Glass molding tongs with both interior and exterior movable forms for molding bottle mouths.

10,151	13,372	13,609	15,157	67,100	86,974	88,440
101,527	134,792	141,984	244,465			

27. Other treatment of glass articles not mentioned in groups 25 and 26, e.g., spreading, folding, manipulation of complete plates, bars, and tubes by means of lamps, processes for spreading out plate glass cylinders, making glass wool. (cf. group 31.)

2,518	22,093	32,027	38,179	49,659	51,358	63,443
63,793	68,272	68,988	77,723	93,117	98,719	109,646
112,249	119,962	124,703	132,584	132,972	133,601	153,383
153,424	154,015	154,609	157,823	159,120	159,614	160,792
160,887	160,890	161,280	162,583	163,060	166,681	168,876
174,793	176,448	176,510	183,526	186,790	202,713	203,760
205,855	211,078	211,843	212,621	212,864	216,371	218,494
220,037	220,533	220,984	222,476	224,035	224,397	224,450
228,049	234,345	237,064	242,247	243,705	244,122	248,483
250,277	251,602	253,716	254,838	255,036	256,658	256,767
256,817	259,766	259,834	262,512	263,406	264,957	267,011
268,141	271,134	275,630	277,443	277,913	294,126	297,361
297,894	304,188	306,004	307,124	318,014	324,749	324,750
326,354	326,615	326,904	326,905	338,932	339,504	341,561
345,146	345,281	349,039	354,568	355,883	357,864	357,865
360,074	360,340	360,341	361,211	367,912	368,907	370,789
377,232	380,948	382,753	388,557	389,480	390,144	393,284
396,050						

Treatment of Glass Articles Subsequent to Forming Processes. (Groups 28-34.)

28. Cooling glass articles in general, e.g., in separate independent compartments.

102	9,930	10,514	68,244	109,364	137,047	186,278
195,969	299,069	284,515	379,537			

29. Continuous cooling of glass articles in conduits or in a series of movable compartments, also cooling conduits in spreading furnaces. (cf. groups 31, 32.)

2,081	3,307	8,100	9,703	11,785	19,207	46,481
95,276	133,342	138,628	148,652	163,059	177,958	187,409
230,833	238,871	251,358	287,838	296,724	314,606	360,778

30. Sudden cooling of glass articles for the purpose of hardening.

1,333	3,794	5,410	6,388	11,055	13,142	31,067
208,289	389,481					

31. Re-heating glass objects until softened in general, e.g., opening furnaces, drum furnaces, re-fusing apparatus, muffle furnaces, ordinary spreading furnaces, including those with cooling conduits. (cf. groups 29, 32.)

19,005	24,955	25,365	39,959	52,899	82,007	82,218
87,784	94,860	109,108	111,392	125,596	127,227	137,976
138,629	148,366	159,119	167,397	189,363	209,540	226,971
227,502	256,080	260,024	282,715	293,343	314,607	356,526

32. Reheating glass objects until soft, in continuous operation with forward movement of the objects, e.g., muffle furnaces, spreading furnaces with mechanical conveyance of the articles.

1,331	14,436	19,333	22,022	51,466	51,974	75,507
84,538	102,538	116,175	121,129	128,666	128,704	134,799
141,144	172,864	177,193	188,284	198,958	202,437	236,171
241,332	244,120	286,102	396,120	400,088		

33. Spreading out and cutting glass objects. (Cutting glass tube into beads group 37.)

1,289	8,089	9,085	14,181	15,903	17,262	24,653
45,271	45,831	63,087	65,341	66,911	68,740	73,114
73,527	85,234	88,521	89,115	90,177	92,761	93,356
106,769	107,050	122,661	113,610	114,293	127,933	134,258
134,583	134,794	138,909	145,096	150,846	158,226	159,850
160,693	168,573	171,057	186,226	192,123	192,685	209,539
212,751	216,572	226,470	229,437	239,571	243,174	244,466
251,359	257,475	260,072	263,727	266,039	272,440	281,987
282,070	283,837	291,392	296,546	316,238	322,109	332,072
333,080	334,982	349,985	353,484	353,539	357,866	360,287
363,620	369,441	383,205	389,523	399,768	402,739	

34. Mechanical insertion of glass articles into the annealing furnace.

29,570	64,023	68,993	80,189	107,787	117,654	119,984
124,701	149,508	159,205	160,692	168,749	169,957	178,577
188,780	189,963	196,027	206,307	220,038	224,451	230,998
258,614	258,998	258,999	262,123	263,918	263,919	264,691
277,198	282,109	283,036	284,092	285,300	288,316	289,326
289,309	297,800	300,305	361,150	384,797	401,595	

Quartz Glass

35. Making and forming of quartz glass and quartz materials. (cf. 80b, 8).

144,913	157,464	159,361	164,619	168,574	169,958	170,234
172,466	174,509	175,385	175,867	176,512	179,570	190,226
203,712	204,537	204,853	204,854	206,545	209,421	224,398
224,917	226,809	235,271	237,817	238,164	241,260	245,908
246,179	246,912	248,985	250,167	250,265	250,918	255,594
256,659	258,351	276,255	277,341	279,128	288,417	293,963
290,606	315,539	317,421	322,956	310,134	338,250	379,245
385,404	395,450	402,445				

32b. Chemical Compounding, e.g., Frits, Fluxes, Coloring, Decoloring, Also Ornamentation of Glass by Changing the Nature of the Surface, as Stained Glass, Etching, Sand Blast Working (sand-blast blowers, class 67), Glass Painting (also class 75d), Coating with Metal, Mirror Making (by galvanic action, class 48a), Art Glazing (Surface ornamentation, class 75).

Glass Compounding. (Group 1-4)

(1.) Compounding colorless glass (also layer glass, devitrified glass).

16,096	23,950	61,573	91,203	101,864	109,712	122,662
126,728	138,630	139,335	156,067	157,135	183,527	240,085
249,647	253,444	273,707	274,133	277,874	360,342	399,692

(2.) Compounding of glass which is uniformly colored, decolored or clouded, in the fused condition.

4,551	24,227	31,112	33,425	61,777	63,558	69,979
73,348	74,565	77,737	88,615	99,165	103,441	108,595
115,016	133,502	133,943	162,607	165,986	182,266	189,364
193,420	193,421	218,316	295,189	331,682	355,591	374,386
374,642						

(3.) Compounding of glass which is not uniformly colored, decolored or clouded in the fused condition (marbled or veined glass and the like).

13,134	54,091	64,249	66,196	73,558	87,100	102,319
125,889	369,442					

(4.) Compounding of glass for production of annealing colors, and with surfaces, colors, e.g., ruby, azure, luster.

17,351	22,306	27,087	46,596	49,014	61,568	68,720
88,441	108,681	111,394	113,370	116,855	122,897	138,281
178,521	178,522	197,663	283,791			

Ornamentation of Glass by Producing Special Surface Modifications. (Group 5-7)

(5.) Ornamentation of glass by producing special surface modifications in the plastic state (e.g., stained glass, crackled glass) (cf. 32a, 20).

24,042	79,922	113,491	130,084	360,343		

(6.) Ornamentation of glass by etching.

6,676	15,590	24,655	26,824	26,825	46,270	57,746
71,653	80,089	85,629	91,286	100,141	148,724	191,519
348,228	350,389					

(7.) Ornamentation of glass by mechanical treatment of the suface, e.g., sand-blast working, damaskeening. (Sand-blast blower 67b.)

562	1,426	1,644	7,722	18,306	24,329	27,618
65,431	84,684	100,140	105,923	281,685	370,740	

Ornamenting Glass by Coating with Vitrified Materials or Metal, and the Manufacture of Decorated Tiles. (Group 8-10.)

(8.) Ornamentation of glass with enamel, e.g., glass painting with enamel.

21,540	22,091	23,351	23,914	26,693	56,791	81,754
97,017	103,304	134,763	286,770	288,062	295,552	313,573
351,820						

(9.) Ornamentation of glass by coating or overlaying with softened glass (exclusive of mosaic overlaying), e.g., flashing, spinning, making mosaic pieces and decorated tiles, exclusive of molding in plastic condition. (cf. 32a, 18.)

12,205	26,094	26,458	57,870	66,213	92,709	93,796
98,930	112,091	114,294	115,811	124,708	139,872	145,391
152,437	156,279	164,443	200,451	230,006	232,377	250,211
263,740	277,444					

(10.) Ornamentation of glass by coating with metal including mirror making, uniting metal and glass by fusion (cf. 32a, 22), lining metal recepticales, e.g., tubes lined with glass, application of gold leaf and the like. (cf. 48b, 2.)

5,623	7,498	7,760	11,298	19,584	20,743	20,900
26,161	29,504	30,226	43,113	44,949	56,259	56,260
68,241	68,782	71,536	74,404	76,622	77,725	82,818
83,502	89,114	90,001	103,586	107,588	108,262	108,737
113,588	115,810	118,708	119,786	122,497	123,089	124,710
128,667	128,705	130,311	133,729	135,640	137,831	144,582
145,629	146,124	147,562	147,583	148,893	149,510	178,520
178,523	186,061	186,830	186,831	196,992	199,115	199,503
241,191	277,814	293,964	332,770	338,067	351,655	390,145
395,978	398,180					

(11.) Ornamentation by assembling glass pieces in frames for windows and the like. (Art glazing, including that in which the frames are formed by casting metal in the joints between adjacent pieces of glass.) (Imitation of art glazing, 75d.)

78	13,738	39,121	76,760	97,540	97,827	97,828
97,829	97,849	97,942	98,467	102,240	110,432	111,995
118,357	120,517	122,661	124,709	127,353	137,048	137,049
148,949	150,388	158,663	171,464	175,386	182,401	183,766
193,370	195,997	198,696	198,911	246,044	300,954	341,361

The Laboratory

Valuation of Etching and Frosting Materials

Fluorine compounds are used to a considerable extent in glass manufacturing. One group of materials containing fluorine is used to produce capacity in glass. To this group belong fluorspar and cryolite. Another group of fluorine compounds is used to produce frosted or matt surfaces on glass or to etch designs into glass surfaces. This group includes hydrofluoric acid and its salts, with ammonium, sodium and potassium.

Analysis of Hydrofluoric Acid

This acid is sold in various concentrations from 30% to 60%. The determination of the total acidity is therefore of interest to the glass chemist. The following procedure is based upon alkalimetric titration of the acid at 0 degrees centrigrade, after first transforming any hydrofluosilicic acid present to potassium fluosilicate. The latter is then subsequently titrated at 90 degrees centrigrade with sodium hydrate solution.

PROCEDURE

Pipette 5-10 cc. of a saturated solution of potassium nitrate into a platinum dish of about 150 cc. capacity and add a few pieces of ice. From a chamber burette add about 85% of the amount of N/1 sodium hydrate solution required to neutralize the acid of the sample and 1 cc. phenophthalein indicator. Allow the solution to cool.

Weigh about 5 grams of the sample (40% HF, or the equivalent of a different strength) in a tared platinum tube with close fitting cover. Immerse the top of the platinum tube under the surface of the alkali solution, remove the cover and mix thoroughly.

Add additional sodium hydroxide solution until a pink color is obtained, which will persist for about 15 seconds. Designate the total number of cc. of solution consumed to this point as "A."

Heat the solution to 90 degrees C. and add N/1 sodium hydroxide solution to a permanent pink endpoint. Designate the number of cc. of this titration as "B."

REACTIONS

At 0 degrees C.:

$$HF + NaOH = NaF + H_2O$$
$$H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O$$
$$H_2SO_3 + 2NaOH = Na_2SO_3 + 2H_2O$$
$$H_2SiF_6 + 2KNO_3 = K_2SiF_6 + 2HNO_3$$
$$2HNO_3 + 2NaOH = 2NaNO_3 + 2H_2O$$

At 90 degrees C.:

$$K_2SiF_6 + 4\ NaOH = 4\ NaF + 2\ KF + SiO_2 + 2\ H_2O.$$

CALCULATIONS

$$\frac{3/2\ B \times .02405 \times 100}{\text{Weight of sample}} = \%\ H_2SiF_6$$

$$\frac{(A - \tfrac{1}{2}\ B) \times .020008 \times 100}{\text{Weight of sample}} - (\%\ H_2SO_4 \times .4079 + \%\ H_2SO_3 \times .4879) = \%\ HF$$

CORRECTIONS

Determine the amount of SiO_2 per cc. contained in the standard alkali solution used for these titrations, then:

$$\%\ HF + \frac{(\text{cc. A} \times \text{gms } SiO_2 \text{ per cc.}) \times 1.9907 \times 100}{\text{weight of sample}} = \%\ HF \text{ (corrected) and}$$

$$\%\ H_2SiF_6 - \frac{(\text{cc. A} \times \text{gms } SiO_2 \text{ per cc.}) \times 2.3933 \times 100}{\text{weight of sample}} = \%\ H_2SiF_6 \text{ (corrected)}$$

NOTE. Sodium hydroxide solutions always contain more or less silica in solution as sodium silicate. This is included in the alkalinity of the solution according to either of the following reactions:

1. $Na_2SiO_3 + 4\ HF = SiF_4 + 2\ NaOH + H_2O$
   $SiF_4 + 2\ HF = H_2SiF_6$
2. $Na_2SiO_3 + 6\ HF = Na_2SiF_6 + 3\ H_2O$

In either case it is evident that both the HF and H_2SiF_6 values are influenced by the presence of silica, in the standard alkali solution to the following extent:

1 mol. of SiO_2 consumes 6 mols. of HF,
1 mol. of SiO_2 produces 1 mol. of H_2SiF_6.

Or, in other words, 1 gram of SiO_2 consumes 1.9908 grams of HF and produces 2.3933 grams of H_2SiF_6. Therefore accurate results cannot be obtained unless the SiO_2 content of the standard solution is known and corrections made accordingly.

The following results illustrate the necessity of making these corrections:

SiO_2 in NaOH Titration A	% HF Uncorrected	% H_2SiF_6 Uncorrected	% HF Corrected for SiO_2	% H_2SiF_6 Corrected for SiO_2
.0020 gms.	45.26	1.24	45.35	1.14
.02336 "	43.30	3.95	44.88	2.04
.03362 "	43.20	3.95	44.79	2.05
.03728 "	43.38	3.84	44.97	1.92
.1223 "	39.24	9.08	45.61	1.42
.1408 "	39.06	8.88	45.40	1.26

The endpoint in the titrations is reliable only when the N/1 NaOH solution is free from sodium carbonate.

The procedure is applicable only when the amount of hydrofluosilicic acid present does not exceed 5 per cent, since larger amounts cause difficulty in obtaining a definite endpoint in the cold titration. Large amounts of hydrofluosilicic acid in hydrofluoric acid may be determined by the gravimetric procedure. Then the HF content may be calculated by the following formula:

$$(A + B) - \frac{\%\ H_2SiF_6 \times \text{Weight of sample}}{.02405 \times 100} = \text{cc. N/1 Na OH equivalent to HF, } H_2SO_4 \text{ and } H_2SO_3.$$

The sulphuric acid is determined by titration with N/1

NaOH solution after expulsion by heat of the accompanying more volatile acids. Sulphurous acid is determined by titration with standard iodine solution.

Analysis of Ammonium Bifluoride

Hydrofluoric acids forms two series of salts, neutral and acid salts. To explain this, the formula for hydrofluoric acid should be doubled, H_2F_2. If only one of the hydrogen atoms is replaced by a monovalent metal, for instance sodium, the acid sodium fluoride is obtained, $NaHF_2$. If both hydrogen atoms are replaced by sodium, the neutral sodiumfluoride is formed. The best material for frosted etching is ammonium fluoride, which occurs in two forms like the sodium fluoride, namely, as acid ammonium fluoride, also called ammonium bifluoride, and as neutral ammonium fluoride.

Ammonium bifluoride, NH_4HF_2, molecular weight 57.15, with 70.2 per cent HF, is a colorless, crystalline substance, having an acid reaction. Its solution gives a matt etching. It is more active than the neutral salt, NH_4F, molecular weight 37.09, containing 54.1 per cent HF. The crystals are colorless and are deliquescent.

The following method for the analysis of ammonium bifluoride is based on the alkalimetric titration of free and combined hydrofluoric acid with standard ammonium hydroxide solution and the titration of combined ammonia by substitution with sodium hydroxide. The procedure is applicable to the crystals and to their solution in water.

PROCEDURE

Transfer about two grams of liquor or salt from a platinum weighing tube to a platinum dish, and add about 20 cc. of water. Titrate the solution with N/2 ammonium hydroxide solution, using methyl orange indicator. Calculate the results to the basis of N/2 ammonium hydroxide on exactly 2 grams of the sample and designate this value as "b."

Reactions:

$$NH_4F.HF + NH_4OH = 2\,NH_4F + H_2O.$$
$$HF + NH_4OH = NH_4F + H_2O.$$

Transfer a second sample (about 2 grams) from a platinum weighing tube to a platinum dish, add about 20 cc. of water and 50 cc. of N/1 sodium hydroxide solution. Boil until all the ammonia is driven off, as shown by the failure of moistened red litmus paper to assume a blue tint when held in the escaping steam.

Neutralize the solution with N/1 hydrochloric acid, using phenolphthalein indicator, and then add about 5 cc. in excess. Boil for 5 minutes to expel carbon dioxide and titrate back with N/1 sodium hydroxide to the neutral point.

Calculate cc. N/1 NaOH — cc. N/1 HCl to cc. N/1 NaOH on a sample weighing exactly 2 grams. Designate this value by "a".

Reactions:

$$NH_4F.HF + 2\,NaOH = 2\,NaF + NH_3 + H_2O.$$
$$HF + NaOH = NaF + H_2O.$$

CALCULATIONS

$$\frac{a \times .020008 \times 100}{2} = a = \text{total F as \% HF.}$$

$$(a - \tfrac{1}{2}\,b) \times .0285 \times 100 = \%\ NH_4F.HF.$$

$$(b - a) = \%\ \text{free HF.}$$

The above calculations are derived as follows:

½ b = cc. N/1 alkali equivalent to "b", then "a" is the N/1 titration of free acid HF + $NH_4F.HF$. ½ "b" is the N/1 titration of free acid HF + ½ $NH_4F.HF$.

Consequently a — ½ b represents the titration of ½ $NH_4F.HF$. But since $NH_4F.HF$ is mono-acid to NH_4OH, the normal factor .057 must be used for calculating $NH_4.HF$ and

$$\frac{(a - \tfrac{1}{2}\,b) \times .057 \times 100}{2}$$

$$= (a - \tfrac{1}{2}\,b) \times .0285 \times 100 = \%\ NH_4F.HF.$$

Since ½ b is the titration of free HF+ ½ $NH_4F.HF$, and a — ½ b is the titration of ½ $NH_4F.HF$, therefore, (b — a) represents the titration of free mono-acid HF, and

$$\frac{(b - a) \times .020008 \times 100}{2} = (b - a) = \%\ \text{free HF.}$$

The accuracy of the results may be checked by the following formula:

(Total F as % HF — % free HF) × 2.85 = % $NH_4F.HF$.

Analysis of Sodium Fluoride

PREPARATION OF THE SAMPLE AND INSOLUBLE RESIDUE. Ten grams of the sample are dissolved in 250 cc. of water and boiled five minutes, then filtered into a liter flask. The residue is washed and ignited. Its weight gives the insoluble residue. Filtrate and washing are diluted to 1,000 cc. and mixed carefully.

SODIUM FLUORIDE. Fifty cc. of the solution, equivalent to ½ gram of the sample, are diluted to 200 cc. in a beaker, ½ gram sodium carbonate added and the mixture boiled. An excess of calcium chloride solution is added slowly and boiled for a few minutes. A small amount of paper pulp is added, the precipitate is allowed to settle and then filtered. The fluoride is washed until free from chlorine.

The residue is ignited in a platinum dish, then treated with 25 cc. of acetic acid and taken to dryness. This treatment is repeated and the residue taken up with a little hot water and filtered. The calcium fluoride is washed free from calcium acetate with small portions of water, remembering that CaF_2 is slightly soluble in water. The ignited residue is weighed as CaF_2.

$$\text{Calculation:}\ \frac{\text{Weight of } CaF_2 \times 1.076 \times 100}{\text{weight of sample}} = \%\ NaF.$$

Jena Glass Filter Apparatus

In THIS JOURNAL, Vol. 7, No. 1 (January, 1926), p. 9, a note was published on "The Valuation of Manganese." For the filtration of nitric acid a filter funnel with a perforated plate and asbestos packing was made use of.

The "Jenaer Glaswerk Schott & Genossen" advise that they have developed filters exactly suitable for this purpose. They are constructed entirely of Jena glass, the filtering disc being made of finely ground glass packed and sintered in the shape of a plate and fused together with the transparent glass container. These filters are ready for use at any time and may easily be cleaned by washing from the reverse side or by suitable chemical solvents. The filter discs (see p. 102) are made of different porosities, the finest being appropriate for the manganese filtration.

Glass Industry

ESTABLISHED 1920

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ADVERTISING RATES SENT ON REQUEST

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As Others See Us

An interesting volume has recently been published in London, entitled "The Secret of High Wages," which is considered one of the most valuable books upon Britain's industrial crisis, that has appeared since the war.

It is a result of a study of American methods of manufacture and of a number of interviews, which the authors have had with some of the leading manufacturers of this country. According to the authors the present prosperous conditions in America are not primarily due to the abundance of natural resources, but are caused by the following facts:

1. America accepts the principle of small profits and quick returns, and wealth is made by small margins of profit on immense and rapid turn over.
2. Rapid turnover is secured by simplification and cheapening of processes which necessitates less capital for a given output.
3. America shows great keenness in devising time-saving and trouble-saving appliances.
4. The American employer is not hostile to high wages.
5. Promotion in America is by merit.
6. Americans are vigilant in eliminating waste and conserving time, energy and space.
7. American welfare methods have a stimulative effect, by surrounding the workers with cleanliness and light and by seeking in every way to increase their conveniences and satisfaction.
8. American manufacturers co-operate by exchanging ideas.
9. Americans encourage research with magnificent intelligence, scouring the world to obtain the best research brains.

Elaborating on the last two reasons for success of the American manufacturer the authors state:

"The most essential step to take for British manufacturers in order to duplicate American prosperity in Great Britain is the breaking down of traditions of secrecy, which divides employers from their workers and from other employers in the same trade. Only then will workers learn to regard their interests as common with those of their employers.

"Exchange of trade information between competitors is essential if the full harvest of improved technical knowledge is to be reaped. Such a policy is largely practiced in America, not for altruistic reasons, but because it has been found to pay."

Covering a World Industry

The past ten years have witnessed a remarkable increase in the literature on the subject of glass technology, both as regards quality and quantity. *The Journal of the American Ceramic Society,* since the formation of the Glass Division, is giving a considerable amount of space to articles on glass. The Society of Glass Technology established in England in 1916 publishes a journal that has become probably the richest repository of knowledge on the subject of glass technology in existence. The German Society of Glass Technology, organized in 1922, has just completed the first volume of *"Glastechnische Berichte,"* published monthly in Frank-

furt-on-the-Main. The official organ of this Society was first printed for two years as a supplement to *"Sprechsaal."* The rapid growth of the German Society of Glass Technology has made possible the independent publication of a monthly journal which already occupies a place of great importance in the world literature on glass.

In 1925 the first comprehensive volume in the English language, covering the whole field of glass manufacture, written by Hodkin and Cousen, was published in London. An enlarged and thoroughly up to date edition of "Dralle, Die Glasfabrikation" is now ready for distribution. This monumental work is, without a doubt, the most important discussion of the glass manufacturing industry ever presented.

Such an amount of literary activity is the natural result of the remarkable strides which the glass industry is making in the principal glass producing countries of the world.

The aim kept constantly in view in the preparation of every issue of this journal has been to publish as much valuable information about the glass industry and its related processes as is available, regardless as to whether progress has been reported at home, in England, France, Germany, Belgium or any other important glass producing center of the world.

The glass industry ranks as one of the oldest occupations of mankind. It supplies one of the fundamental needs of the race, and is the means of support of workers in many lands. It may truly be termed a world industry. To confine an inquiry as to its progress to only one country would be an act of narrow provincialism.

The number of problems with which the industry is confronted is so great that the combined efforts of the glass producing nations of the world will not suffice to solve more than a small fraction of them. To become a clearing house of knowledge concerning glass, gained anywhere in the world, is a stupendous task, but, with a due sense of our limitations, we aspire to establish nothing less than this.

In the December number of each yearly volume of GLASS INDUSTRY an index is bound in the magazine, of the contents of the twelve numbers issued during the year. Through this index it is possible to refer to each article at a glance. It is especially convenient when issues are bound in yearly volumes.

Reference books, valuable as they are for the advancement of knowledge, become obsolete in a few years, due to the rapid strides that are being made from year to year in the glass industry. This journal aims to be a reference library of the industry. Through its possession the reader has a source of information that is constantly being supplied with new material, constituting a technical library which is always up to date.

The subscriber who merely glances through the journal and discards it as if it were a daily newspaper, is losing information that sooner or later may be urgently needed, to be obtained only at considerable cost.

We can conceive of no greater satisfaction, from an editors' standpoint, than to have the GLASS INDUSTRY preserved by its readers, and by having it referred to frequently for the information which it supplies. To make it worthy of preservation is our sincere desire, and no effort is considered too great to realize this end.

Technical Consultation Service

QUESTION 89.—Please give us a batch for "Royal Blue" glass.

ANSWER. The following batch should be tried out on a small scale:

Sand	100 parts
Potash	38 "
Marble	12 "
Calcium Phosphate	25 "
Copper Sulphate	8 "
Arsenic	1 "

QUESTION 90.—What is Euphos glass and what is Uviol glass?

ANSWER. Euphos glass was invented by Drs. Shanz and Stockhausen of Dresden, Germany. It has the property of being impervious to ultra-violet light rays and is used in Germany to produce glass for the manufacture of electric light bulbs. Since these light bulbs do not transmit the harmful ultra-violet rays, they produce a light which is restful to the eye, in contrast to the light emitted by the usual electric light bulbs, which has a tendency to hurt sensitive eyes.

Euphos glass was made originally in five light shades, numbered from 1 to 5, wherein the yellow predominated, and five dark shades, lettered A to E, wherein the green was more perceptible. At the present time it is supplied in two shades, light and dark.

Electric light bulbs made of Euphos glass are being manufactured by Putzler Bros. Glass Works, Penzig, Silesia.

Uviol glass, made by Schott und Genossen, Jena, Germany, has properties which are directly opposite to those possessed by Euphos glass. It transmits practically all ultra-violet rays, whereas ordinary glass absorbs a large part of them. It is used to manufacture objectives for celestial photography, since it transmits the rays of stars which are invisible to the eye, due to the fact that they emit only ultra violet rays. It is also used for the manufacture of mercury arc lights, which depend for their effect on the complete transmission of ultra-violet rays.

QUESTION 91.—Please give us a method for analysis of glass, colored by a mixture of iron and copper. It is desired to determine the quantities of the coloring materials used.

ANSWER.—The determination of the two metals can be made on the same sample. Weigh out one gram, fuse with sodium carbonate and separate the silica by evaporation with hydrochloric acid as usual. To the filtrate from the silica add an excess of ammonia. This will precipitate the iron as $Fe(OH)_3$, but will not precipitate the copper, which passes into the filtrate, giving it a blue color if present in any appreciable amount. The amount of copper may then be determined by matching the blue color in an equal volume of ammonia, to which known amounts of copper nitrate are added until the colors are identical. It is best to use a solution containing .0005 grams of copper per c.c.

The iron precipitate contains any alumina present in the glass. It is dissolved on the filter in hot hydrochloric acid solution 1:1, boiled down to remove most of the acid, reduced with a few drops of stannous chloride, and the excess of stannous chloride removed by the addition of mercuric chloride solution. Dilute with cold water, add 30 c.c. of "titrating solution" (containing 67 grams $MnSO_4$, $4H_2O$, 138 c.c. H_3PO_4 and 130 c.c. H_2SO_4 diluted to 1,000 c.c.) and titrate with standard permanganate solution.

For very accurate work the copper solution should be made neutral with nitric acid, five c.c. sulphuric acid, 1:1 added and the solution electrolyzed. The presence of any arsenic in the glass does not interfere with the accuracy of this process, since it is removed with the iron. If the amount of iron is very small, it is advisable to determine the copper on a separate sample, add a little ferric sulphate and remove the total iron with ammonia. This will insure complete removal of any arsenic present, which otherwise might be precipitated with the copper and vitiate the result.

New and Enlarged Edition of "Dralle, Die Glasfabrikation" Now Available

DIE GLASFABRIKATION, by Robert Dralle, second, completely rewritten and enlarged edition, edited by Dr. Gustav Keppeler, Professor at the Technical University of Hanover, in collaboration with prominent glass technologists. First Volume, with 714 illustrations and 16 folded inserts. 766 pages. Size 8 x 11 inches. Published by R. Oldenbourg, Munich and Berlin. For sale by the GLASS INDUSTRY, 50 Church street, New York. Price $16.00 postpaid.

The appearance of a new edition of "Dralle, Die Glasfabrikation" is an event to which many have looked forward with great interest. The old edition of 1911, which has generally been recognized as the most comprehensive description of the glass manufacturing industry in existence, has been exhausted for some years. The rapid strides made by the glass industry since the year of its publication has made it necessary to completely review and rewrite most of the material appearing in the earlier volume. On account of the death of its original author, Robert Dralle, in 1918, the task of editing the new volume has fallen to Dr. Gustav Keppeler, Professor at the Technical University of Hanover, who was a co-author of the book in its first edition. The following glass technologists, manufacturers and scientists have co-operated in the production of the present volume:

F. Eckert, Ruhr Glassworks, Essen.
W. Frommel, Glass manufacturer, Ujpest near Budapest.
D. E. Lutz, Glass manufacturer, Dessau.
H. Maurach, Permanent Secretary, German Society of Glass Technology, Frankfurt-on-the Main.
H. Muhlert, Gerresheim.
Ludwig Springer, Glass Technologist, Professor at the Glass Trade School of Zwiesel, Bavaria.
O. Wolf, Glass manufacturer, Crefeld-Linn.
F. Wollner, Glass manufacturer, Ratten, Steiermark.
A. Wendler, Berlin.

To give an adequate description of a work of this character is very obviously impossible, and it will be sufficient to enumerate the subjects treated in the first volume, soon available. In the first chapter by Dr. Keppeler the physical and chemical foundations of glass manufacturing are discussed, with special attention to normal melting and solidification, glassy and crystalline solidification and devitrification. The properties of glasses and the effect of the chemical composition of glass on its physical properties are set forth at length.

The second chapter is devoted to raw materials of the glass industry and their preparation; the third chapter describes the melting, refining, cooling and annealing operations. Other chapters are devoted to fuels and the operation of gas producers. Dr. Maurach has contributed a chapter on the control of furnace operation. Refractories are discussed in chapter 7 and chapter 8 is devoted to glass furnaces.

Of outstanding importance to the American glass manufacturer is the closing series of articles by Dr. A. Wendler, discussing in considerable detail the various types of modern glass working machinery. It is certain that nowhere in the literature on glass has anything appeared, which even remotely resembles the thoroughness of treatment of this subject. Dr. Wendler has a remarkable grasp of this complicated and difficult branch of engineering, and has presented it in an interesting and authoritative manner.

One of the outstanding features of the book is the number and perfection of its illustrations, and the excellent typography. The volume is a credit to the authors and a monument to the originator.

The publication of the second volume is expected to take place within a year.

CULLET PILE PHILOSOPHY

By SILICA SAM

A Safety Measure

We were sorry to read, not long ago, of the misfortune one company had of losing a huge tank furnace and the attending damage when the glass ran on back under the plant causing fire, damage and destruction. New tank furnaces are now being built with a pit or bowl underneath capable of holding all the glass from the tank.

In old established plants, it is not always possible to construct such a pit, but sometimes a wall is built in the basement either around the area under the tank or across between that part of the basement under the tank or tanks and the parts of the basement adjacent.

This wall may well be built out of old odd shape tank blocks which were left over years ago when the furnace design was changed. Bottom blocks which were not more than half gone when taken up may be used—and there's always some used checker brick and fire brick around. Thus this safety wall need cost little except labor and it's always there to stop misfortune and damage from running into disaster.

Water Line Troubles

Where water is pumped direct into lines or through storage tank into lines from a river or any source that is apt on occasions to become polluted with leaves or other dirt capable of stopping up in the lines, serious trouble may occur with water coolers going dry. When this happens there isn't much time to spare and it will be found to be a life saver if there are two connections of flexible hose with stop cocks at their ends from the main to each end of the cooler. This makes four possible inlets. This means that there must be at least two outlets—one at each end of the cooler and they should be fitted with stop cocks so the one at the same end as the inlet in use can be shut off. This arrangement gives opportunity to take off and clean out any of the three inlets not in use and leaves two spares for safety while one is in use and one is disconnected and being cleaned.

Fire Drill

"What would your men do in case of fire?"—Give the signal and see! The plant may be equipped with sprinkler systems. There may be innumerable extinguishers placed conveniently and the equipment in the hose houses may be kept up in very good shape. But do the men know their stuff?

There's but one way to find out and you'll find out that they do not. Then is the time to plan the duties of each department foreman and his men and see that they fully understand. And try them out again soon and go over the whole matter again. After they are able to perform satisfactorily it will be found necessary to drill them at least once a month to keep them in practice at all. It costs something but you'll agree that results justify the costs if you try it a while.

If one does the best he can he will find, nine times out of ten, that he has done as well or better than anyone else.

A manufacturer's profits are equal to his margin of efficiency over that of his least efficient competitor.

Many an opportunity knocks at a business man's door when he is "in conference."

Recent Patents

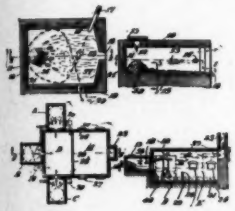
NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

Shively Patents Novel Glassmaking Process

A patent (No. 1,575,514) on a new method of making glass was issued by the United States Patent Office on March 2, 1926, to R. R. Shively of Washington, Pa., assignor to B. F. Drakenfeld & Co., Inc., New York.

In his description of the new process, the inventor states that relatively small quantities of raw material of which the glass is to be made, are subjected to a melting temperature and the melted glass flows away from the raw material as it melts, the melted glass being subjected simultaneously to the high heat so as to weld or fuse any entrained raw material. The raw material is thereby entirely fused into glass, and simultaneously, being subjected to the high temperature, any bubbles, seeds, etc., are eliminated quickly. In other words, it is "plained," a term well understood in the art.



The maintenance of the glass after it is formed from the raw material, in a fluid state enables the bubbles or seeds to readily pass off due to the high viscosity maintained. During the formation of the glass, its flowing and its plaining, with the high temperature acting upon relatively small quantities of the glass, it is desirable to maintain the glass flow on the floor of the furnace in a spread out condition, so as to enable the high temperature to act on all portions thereof and throughout its depth.

The high temperature acting upon the raw material, a film of fused glass surrounds the raw material which thereby prevents volatilization and holds the raw material captured. This coating of fused glass then flows off from the raw material and the high temperature acting upon a relatively thin layer readily brings about the condition referred to as plaining. A glass is thereby produced that is ready to be utilized either for blowing or pressing into a finished product.

Plaining can be controlled by variations in the inclination of the floor of the fusing chamber. The receiving chamber is maintained at a relatively low temperature and this assures long life of the clay products of which it is constructed.

In this new method the glass is not subjected to a melting temperature for more than a few minutes. The equipment required is relatively small and inexpensive.

The reduction of losses by volatilization is of particular importance in the case of opal or white glasses, colored glass and other special glasses. The excess heat from the high melting chamber is utilized in the receiving chamber for maintaining the collected glass in a molten condition to enable it to be worked. All of the melting takes place in the melting chamber.

When the glass is cooled in the receiving chamber, which has a temperature less than that of the melting chamber, the glass is not likely to take up from the receiving chamber walls any foreign material which will produce strains or cords.

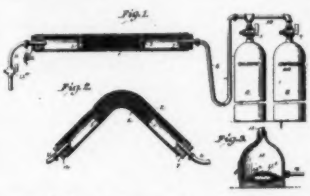
The two upper illustrations show horizontal and vertical sections of the furnace with the direction of the flame indicated. The two lower diagrams show an arrangement of three furnaces with a single collecting chamber and working chamber.

The patent covers the process consisting in melting continuously in a single operation small quantities of glass material and simultaneously removing the fused material as it is melted, such removing being continuous with the melting operation; and also equipment for carrying on the process.

METHOD AND APPARATUS FOR ANNEALING GLASSWARE. U. S. 1,571,137. Jan. 26, 1926. Vergil Mulholland, West Hartford, Conn., assignor to Hartford-Empire Company. Filed 3/31/25.

A full description of the Hartford-Empire lehr appeared on pages 73-75 of the March, 1926, issue of THIS JOURNAL. Articles to be annealed are passed from forming machine into the lehr while still very hot. Very little heating is required.

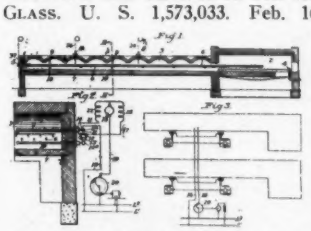
METHOD OF HEATING METAL, GLASS, OF OTHER MATERIAL TO RENDER THE SAME WORKABLE. U. S. 1,572,975. Feb. 16, 1926. James W. Van Meter, San Rafael, Cal. Filed 6/5/22. Provides an improved method by which metal, glass or other material can be heated in a very short time, at minimum cost, and without the employment of expensive furnaces or apparatus or fire or electric current, the invention consisting in exposing such material to the action of heat generated by the chemical reaction of a reaction causing agent, such as for instance, chlorine, on a body of initially inert material such as particles of zinc, iron, lead, arsenic or other metal.



A sufficient charge of such material which may consist preferably of sawdust, which contains some moisture, bran, or the like is mixed intimately with an initially inert material, such as particles of zinc, iron, lead or other metal, or arsenic and confined at the desired point by means of wads of loose asbestos. A sufficient quantity of a reaction causing agent, such as for instance, chlorine, is provided, also means to force air through the said tube to the body of initially inert material, and means to control the passage of chlorine gas from the tank to the work.

As the chlorine comes in contact with the initially inert material it reacts chemically on the metal particles, zinc, iron, lead or the like in the charge and an intense heat is instantaneously developed, without the aid of oxygen, and to which the work is exposed, and by which the work, whether as in this instance a pipe, or other article or object, and whether made of iron, steel, or other metal, or of glass, porcelain or other material, is in a very short space of time rendered workable so that it can be bent or otherwise worked.

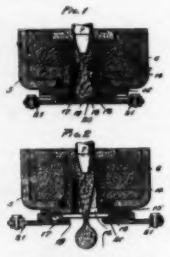
METHOD AND APPARATUS FOR ANNEALING AND COOLING SHEET GLASS. U. S. 1,573,033. Feb. 16, 1926. Frederic L. Bishop, Pittsburgh, Pa., assignor to Window Glass Machine Company. Filed 9/4/24. In the copending application of John Hartzell, Serial No. 693,249, filed Feb. 16, 1924, there is shown a lehr for use in connection with the annealing and cooling of sheet glass which lehr is adapted for the passage of gaseous fluid in streams above and below the glass, together with means for varying the relative cooling effect of the two streams. The present invention is applied to one form of lehr shown in the Hartzell application, although it may be readily applied to various other forms of apparatus. In those cases where the glass travels horizontally, apparatus similar to that shown in the drawings may be used. Where the glass is drawn in a vertical direction, regulating means may be provided on one or both sides of the glass sheet.



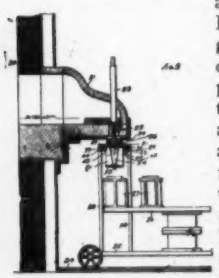
METHOD OF AND DEVICE FOR DRAWING TUBES. U. S. 1,574,482. Feb. 23, 1926. Richard Hirsch, Jena, Germany, assignor to the Libbey Glass Company, Toledo, O. Filed 4/17/25. Glass tubes of circular cross section are made by conducting, on a body of circular cross section, which is disposed in an inclined position and rotatable, molten glass, and by drawing the latter off as a tube at the lower end of this body. If the delivery end of the aforesaid body or mandrel is smaller than the receiving end, a tube may be produced having different shapes on the inside and outside, corresponding respectively to the delivery end and receiv-

ing end of the mandrel, whereas, if the delivery end is larger than the receiving end, both the inside and outside of the resultant tube is of substantially the same shape as the delivery end of the mandrel.

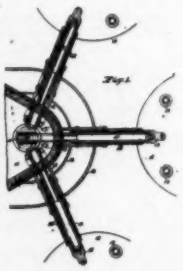
METHOD OF FEEDING GLASS TO FORMING MACHINES. U. S. 1,573,635. Feb. 16, 1926. Leo A. Drey, St. Louis, Mo., assignor by mesne assignments, to Ball Brothers Company. Filed 12/14/24. This invention relates to improvements in methods of feeding glass to forming machines, wherein a controlled stream of glass is gathered in batches in a heated chamber on a support which is withdrawn upon an operation of a forming machine before the complete filling of the chamber, to the end that the batches are maintained in a heated chamber during their times of gathering and a minimum of their surfaces are contacted before being fed to the forming machine. This application is a division of co-pending application Serial Number 877,070, filed December 14, 1914, and patented July 13, 1915, Number 1,146,694.



APPARATUS FOR FEEDING GLASS INTO MOLDS. U. S. 1,573,636. Feb. 15, 1926. Leo A. Drey, St. Louis, Mo., assignor, by Mesne assignments, to Ball Brothers Company. Filed 10/18/26. In an apparatus for gathering molten glass from a continuously flowing stream, comprising a supporting plate provided with an opening through which the stream of glass passes, a knife slidably mounted on said plate and adapted to move over said opening for preventing the passage of glass therethrough, a scraper plate carried by said plate and located above said knife, a bottomless cup composed of separable members slidably secured to the underside of said plate and adapted to surround said opening, and means for periodically separating said members for dropping accumulated glass therefrom into the molds of a glass forming machine.



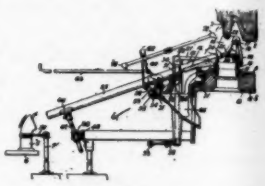
GLASS-FLOWING DEVICE. U. S. 1,573,273. Feb. 16, 1926. Claude W. Pleukharp, San Francisco, Cal., assignor to Illinois-Pacific Glass Company. Filed 2/23/22. A series of troughs or chutes arranged radially about a single charging vessel, each of the chutes connecting with a turret or mold-carrying device and being provided at its inner end with a reciprocating part so controlled and actuated as to move forwardly into position beneath the charging nozzle to receive its charge of molten glass, the reciprocating parts of the other chutes following in succession. The controlling means is so arranged as to allow any one of the chutes to be cut out without interrupting or interfering with the operation of the others. By dispensing with the customary swinging chute and using the reciprocating extensions for each of a series of chutes or troughs the number of molds that can be supplied is not limited to two as in the apparatus previously employed.



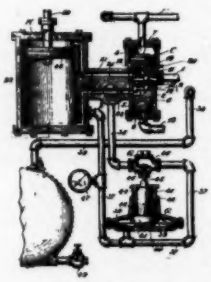
DRAWING SHEET GLASS. U. S. 1,574,984. Mar. 2, 1926. Thomas C. McKinley, Charleston, W. Va., assignor to the Libbey-Owens Sheet Glass Company. Filed 11/5/23. The object is to prevent condensation of water on the coolers mounted close to the sheet in the Colburn process of drawing sheet glass. In the improved form of cooler this is accomplished by providing hollow compartments or air-jackets along the two vertical sides of the water compartments so that the cooling effect of these portions of the apparatus will be tempered to such an extent that the condensation on the exterior walls will not take place.

GLASS-CUTTER'S TABLE. U. S. 1,574,965. Mar. 2, 1926. Lawrence A. Grolemund, Charleston, W. Va., assignor to the Libbey-Owens Sheet Glass Company. Filed 11/12/23. The two scale members carrying the positioning and holding pins are movable lengthwise of the table and when it is desired to measure the sheet in fractions of an inch means are provided for simultaneously adjusting these two slides the desired fraction of an inch away from the fixed table edge. If the straight-edge is then positioned against the pins for the desired even number of inches the fractional inch measurement will automatically be added. The glass sheet is lined up even with the fixed edge of the table as is the case when the table is normally used for measuring even inches.

GLASS-DELIVERING APPARATUS. U. S. 1,575,370. March 2, 1926. Edward H. Lorenz, West Hartford, Conn., assignor to the Hartford-Empire Company. Filed 4/7/19. A glass delivering apparatus adapted to deliver charges of glass from a feeding means to forming machinery, comprising a distributer and a conduit, the distributer receiving the glass charges and delivering them to said conduit, whereby they are delivered to said forming machinery and means for moving the conduit relative to the distributer thereby arresting the delivery of the charges from the distributer to the forming machinery.

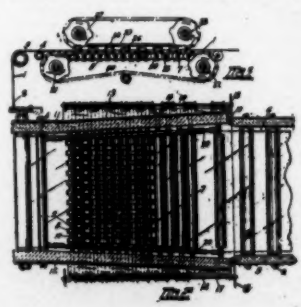


GLASS MACHINE. U. S. 1,574,903. March 2, 1926. Peter P. Kucera, Connellsville, Pa., assignor to Capstan Glass Company. Filed 3/24/20. Objects of the invention are to provide control mechanisms for the glass shaping operation, to predetermine the pressures operating during the shaping operations, to automatically decrease the pressing pressures after the glass has completely filled the mold, to automatically relieve the pressing pressure when it has been built up to a predetermined amount. A further object is to perform the shaping of the plastic glass under a full pressure head and the setting of the glass after being formed under a reduced pressure head; also to control pressing operations by means of a plurality of inter-related controlling devices arranged in such manner as to cause the initial operations to take place under a relatively high pressure head and the final operations to take place under a reduced pressure head.

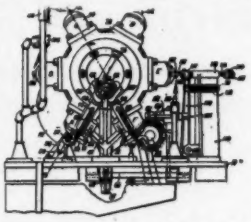


DRAWING AND FLATTENING TABLE FOR SHEET GLASS. U. S. 1,575,006. March 2, 1926. Clifford A. Rowley, Toledo, O., assignor to the Libbey-Owens Sheet Glass Company. Filed 1/25/24. A drawing and flattening table for sheet glass, comprising an upper stationary table and a lower stationary table, the tables each having upper flat horizontal supporting surfaces, a series of flat sheet-supporting plates, and means for moving the plates successively along the upper table beneath and with the glass sheet, and then returning them along the lower table, the sheet-supporting surfaces of the plates always remaining uppermost, and out of contact with the tables.

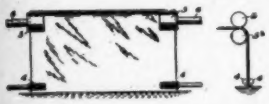
DRAWING AND FLATTENING TABLE FOR SHEET GLASS. U. S. 1,575,007. March 2, 1926. Clifford A. Rowley, Toledo, O., assignor to the Libbey-Owens Sheet Glass Company. Filed 1/30/24. In a sheet glass drawing apparatus, a supporting and flattening table for the moving sheet, formed of a plurality of closely positioned parallel rollers, the upper sheet-supporting surfaces of the rollers all lying in the same plane, in combination with continuous means at the sides of the table for supporting and drawing longitudinally the edge portions.



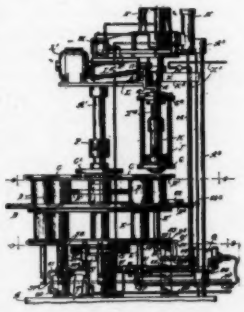
GLASS-WORKING MACHINE. U. S. 1,576,221. March 9, 1926. Francis J. Rippl, Cleveland, O., assignor to General Electric Company. Filed 10/18/19. In a machine for shaping glass tubes, especially those used for making incandescent lamps, the combination of a carrier rotatable in a substantially vertical plane, a holder mounted thereon having a passage therethrough disposed so as to allow a glass tube to feed therethrough by gravity, and means for gripping said tube, means disposed in the path of travel of said holder whereby tubes may be fed to said holder, tube heating and shaping means disposed in the path of travel of said holder, and means automatically brought into operation for periodically opening said gripping means to discharge a tube and for subsequently causing said gripping means to close upon a fresh tube.



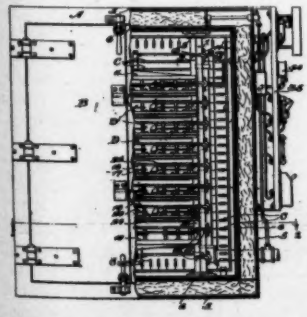
DRAWING GLASS SHEETS. U. S. 1,576,446. March 9, 1926. William L. Munro, Pittsburgh, Pa., assignor to Window Glass Machine Company. Filed 4/23/20. Apparatus for drawing sheet glass, comprising a bath of molten glass, means for reducing the temperature of a portion of such bath so as to define a region of lower temperature from which a sheet of glass may be drawn, a plurality of bending roll portions spaced from said bath and so positioned as to draw a sheet from the region of lower temperature in the bath, the bending roll portions being spaced apart and adapted to change the direction of travel of the sheet, the portion of the sheet between such portions being out of contact with the bending roll, and width maintaining means adjacent the bath, said means engaging the same portions of the sheet as are afterwards engaged by the bending roll portions.



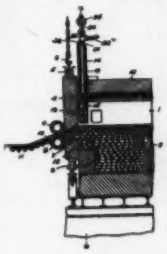
MACHINE FOR MAKING GLASS CONTAINERS. U. S. 1,576,114. Mar. 9, 1926. Warren E. Glaspey, Bridgeton, N. J., assignor to Spring Stopper Company. Filed 10/22/23. The primary object of the invention is to adapt a machine of the press and blow type to the production of containers provided with internally threaded mouth portions; and the invention involves the combination with the mechanisms of a machine for pressing and blowing a container, of means cooperating with such mechanisms for producing internal threads in the mouths of the containers. The cross-head has mounted therein an annular mandrel which embraces the tool-portion of the press-plunger, said mandrel having its tip-portion equipped with a thread which is adapted to mold a thread in the container-mouth.



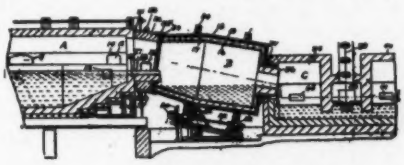
APPARATUS FOR FABRICATING RE-ENFORCED GLASS. U. S. 1,575,969. Mar. 9, 1926. William C. Bull, Brooklyn, N. Y. Filed 6/26/24. Relates to apparatus for fabricating laminated or reinforced non-shatterable and scatterless glass. An improvement of the type set forth in copending application filed June 26, 1924, Serial No. 722,518. A primary object is to provide a novel multiple press device including a plurality of relatively stationary press units each having its own individual pressure applying means, all of such means of all of the units, however, being subject to common and uniform control from a single point or operating station.



GATE FOR GLASS TANKS. U. S. 1,572,481. Feb. 9, 1926. Halbert K. Hitchcock, of Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Company. Filed 2/16/24. Consists of a lower water cooled part preferably made of heat resisting metal such as nichrome and an upper part made up of refractory material such as brick. The temperature of the lower member is such that the glass in contact with it is solidified, and as glass is a relatively poor conductor, this socket of chilled glass protects the said member from the relatively high temperature of the molten glass and prevents any great amount of chilling of the molten bath.



PROCESS AND APPARATUS FOR REFINING GLASS. U. S. 1,577,602. Mar. 23, 1926. Walter O. Amsler, Toledo, O. Filed 3/30/25. The process which consists in melting glass, introducing the molten



glass into one end of a refining pool, refining the glass in the pool while rolling it about the longitudinal axis of the pool, and discharging the refined glass from the other end of the pool.

GLASS-FORMING APPARATUS AND METHOD OF FORMING GLASS. U. S. 1,576,743. Mar. 16, 1926. Orin A. Hanford, Columbus, O., assignor to the Federal Glass Co. Filed 4/14/21. Glass blowing apparatus comprising means for oscillating a blank at an angle from the vertical and about its own axis, the oscillation of said blank being such that the sides will be alternately stretched and compressed.

METHOD AND APPARATUS FOR DELIVERING MOLTEN GLASS. U. S. 1,574,739. Feb. 23, 1926. Enoch Theodore Ferngren, Toledo, O., assignor to the Hartford-Fairmont Co. Filed 9/29/13.

PROCESS AND APPARATUS FOR ANNEALING A CONTINUOUSLY-FORMED GLASS SHEET. U. S. 1,576,516. Mar. 16, 1926. Walter G. Koupal, Tarentum, Pa., assignor to the Pittsburgh Plate Glass Co. Filed 5/13/24.

PROCESS OF MAKING GLASSWARE. U. S. 1,576,733. Mar. 16, 1926. Enoch Ferngren, Washington, D. C. Filed 1/20/20.

CUTTING APPARATUS. U. S. 1,576,734. Mar. 16, 1926. Enoch T. Ferngren, Toledo, O., assignor to Owens Bottle Co. Filed 6/12/22.

APPARATUS FOR BLOWING GLASSWARE. U. S. 1,576,744. U. S. Mar. 16, 1926. Orin A. Hanford, Columbus, O., assignor to the Federal Glass Co. Filed 8/22/21.

APPARATUS FOR BLOWING GLASS. U. S. 1,576,745. Mar. 16, 1926. Orin A. Hanford, Columbus, O., assignor to the Federal Glass Co. Filed 10/17/21.

METHOD OF AND MEANS FOR DRAWING GLASS CYLINDERS. U. S. 1,577,007. Mar. 16, 1926. William Westbury, Independence, Kans., assignor, by mesne assignments, to Harding Glass Co. Filed 5/12/22.

GLASS-DRAWING APPARATUS. U. S. 1,577,008. Mar. 16, 1926. William Westbury, Independence, Kans., assignor, by mesne assignments, to Harding Glass Co. Filed 5/12/22.

APPARATUS FOR SEVERING GLASS. U. S. 1,577,536. Mar. 23, 1926. Alvah C. Parker and Carl W. Schreiber, Toledo, O., assignors to the Libbey Glass Manufacturing Co. Filed 4/3/24.

APPARATUS FOR BURNING OFF GLASS. U. S. 1,577,537. Mar. 23, 1926. Alvah C. Parker, Toledo, O., assignor to the Libbey Glass Manufacturing Co. Filed 4/7/24.

APPARATUS FOR BURNING OF GLASSWARE. U. S. 1,577,538. Mar. 23, 1926. Alvah C. Parker, Toledo, O., assignor to the Libbey Glass Manufacturing Co. Filed 11/1/24.

METHOD OF AND APPARATUS FOR SEVERING GLASS. U. S. 1,577,543. Mar. 23, 1926. Ernest C. Schrader, Toledo, O., assignor to the Libbey Glass Manufacturing Co. Filed 3/26/23.

METHOD AND APPARATUS FOR BURNING OFF GLASS. U. S. 1,578,098. Mar. 23, 1926. Ernest C. Schrader, Morgantown, W. Va., assignor to the Libbey Glass Manufacturing Co. Filed 6/14/24.

Glass Factory Equipment and Supplies

Most of the information printed in this department comes direct from the manufacturers of the products described.

Glass Filter Apparatus*

By Dr. Paul H. Prausnitz

Until recently glass filters were not employed for chemical laboratory work, notwithstanding the fact that fritted glass is hardly liable to be attacked by chemicals agents.

The Jena Glass Works of Schott & Genossen are now making glass-filter-apparatus on the following new principle: High grade glasses of good chemical and thermal resistance are ground and sieved; particles of equal size are fused to form filter-discs containing pores of fairly equal diameter; and these discs may be fused together with the same kind of glass shaped in various patterns.

According to the numbers of mesh given to the sieves employed for sorting the grades of glass powder, the average size of pores has been determined as follows: From 2 to 3, 110 μ; 3 to 5, 60 μ; 5 to 7, 40 μ, and <7, 5 μ. Glass powder, not being plastic, like clay or fuller's earth, the manufacturing method had to be adapted to the burning of dry powder in flat moulds. By this means filter-slabs with large pores may be made as readily as fine-pore filters, whereas hitherto the production of filters with large pores of uniform size, made of plastic material, has been somewhat unsatisfactory.

To eliminate paper filters in those cases in which precipitates are to be filtered and weighed after being dried or heated at certain given temperatures, the Gooch crucible (with asbestos filters), and the Neubauer crucible (with platinum black filters) have been developed. The latter are relatively expensive, the former want careful preparation. Several types of crucibles have recently been made containing filters ready for use at any time. The Norton Company made crucibles of porous alundum, the Schott Glass Works brought out filter apparatus made of glass, the Berlin and the Rosenthal porcelain factories produced crucibles containing porous china filter discs. The alundum crucibles which I came across were porous throughout; this has the disadvantage that the liquid to be eliminated creeps up the walls and is not easily washed out. The glass and the porcelain crucibles, like the older Gooch crucible, having glazed walls and only filtering discs at bottom, offer far better possibilities for removing the liquid and washing the precipitate. The alundum and porcelain crucibles stand high temperatures better. But, on the other hand, the glass filter apparatus has the following two very great advantages, due to the same reasons that glass is the chief material for *all* kinds of laboratory work: glass is *transparent*, and glass is most easily *brought into every shape* that may be necessary for the work on hand.

If highest thermal resistance is to be combined with transparency, *quartz* apparatus may be used; crucibles of transparent quartz fused with silica filter discs combine these advantages.

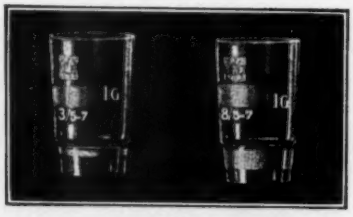


FIG. 1

For quantitative analysis, especially when drying temperatures of 110 to 150° C. are required, the glass filter crucible is the best shape (Fig. 1). If it is to be heated to red heat, a temperature up to 600° C. may be employed, but in that case it is preferable to use an electric furnace permitting of a slow and regular heating and re-cooling of the glass crucible. For filtering, the crucible is fitted into an adapter by means of a rubber ring. The adapter is placed on a suction-bottle joined to an air-pump. Coarser precipitates, such as silver chloride, are retained by medium-pore filters (type 5-7); but, as a rule, fine-pore filters (<7) are preferred, suited as they are for retaining fine precipitates such as cuprous oxide or barium sulphate. I may add that ultra-filtration with the Schott crucibles has so far not been attained unless a layer of an adequate material has been placed on top of the filter-disc.

In the case of white precipitates filter-apparatus with colored glass discs are available. These may be fused with white glass mantles, so that the whole process of filtration can be closely followed.

For preparing chemical compounds, a whole series of Buchner funnels, up to 120 mm. diameter, partly illustrated in Fig. 2, is

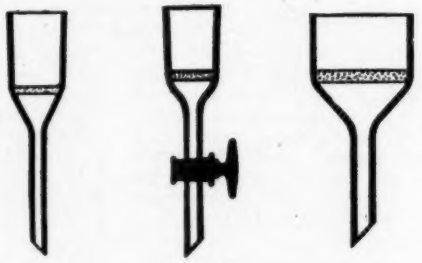


FIG. 2

available. Coarser precipitates are retained by large-pore filters. These may be cleansed by rinsing with water from the reverse side. Finer filters, when clogged, may be purified by solvents. Precipitates which are fine, but absolutely insoluble (silicates, highly ignited oxide of iron, and the like), had better not be used, for in such cases the filters may be clogged and definitely spoiled. Should the precipitate be of special preparative value, as is often the case, the filter disc may be given a high polish before it be fused into the funnel. From a polished filter the finest precipitates are removable by means of a rubber device. In the case of red phosphorus, for example, suspended in water, it is possible to remove the fine colored substance almost completely from a polished filter—certainly to a much greater extent than from a paper filter.

*Abstract of article published in *The Analyst*, the Journal of the Society of Public Analysts and other Analytical Chemists.

Cleveland Window Washing Cage—Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Company, Wickliffe, O., have issued a folder describing their tramrail window washing system in which a workman's cage is suspended from a rail attached to the wall or overhanging roof of the building. One man can raise, lower or propel the cage around the building. The manufacturers state that by the use of this equipment not only is the workman made safer and more comfortable, but the window cleaning can be done so much quicker that half the ordinary cost can be saved. Furthermore, with such convenient equipment the windows are likely to be washed oftener, thus providing more light and thereby adding to the efficiency of the indoor workmen.

Steam Turbines. General Electric steam turbines rated at 500, 600 and 750 kw. are described in Bulletin GEA-235, issued by the General Electric Company, Schenectady, N. Y. The general principles and advantages of steam turbines are discussed, and sections and steam path diagrams are shown.

Plastic Fire-Clay Refractories. United States Government Master Specification No. 335. Bureau of Standards, Department of Commerce. Copies may be obtained from Superintendent of Documents, Washington, D. C., at 5 cents each.

The Glass World and What It Is Doing

News of the Industry

Wired Glass Not Involved in Equitable Building Fire

When publishing an account of a fire, "probably the highest the world has known," which destroyed all of the furnishings and contents of a filing room on the 35th floor of the Equitable Building, New York, it was stated in one of the city newspapers that the spread of the fire was due to the failure of wired glass. This statement was the cause of considerable concern to insurance and glass men, architects, builders, owners, bankers and investors, anxious inquiries being received even from Europe where the report threatened to injure the building and wired glass industry, the report being taken as indicating that tall buildings were not actually fireproof.

In ascertaining the facts in the case the GLASS INDUSTRY learned authoritatively that the fire did not start in a wired-glass enclosed elevator shaft as reported, but originated in some unknown way near the bottom of a 12 x 12-foot pipe shaft where night workman were making repairs. Burning pipe insulation and other inflammable material caused a 5-inch gas pipe to crack. This resulted in a heat sufficient to melt almost anything. The flames entered the filing room on the 35th floor through a working door in the pipe shaft which had negligently been left open.

Basing his statement to the GLASS INDUSTRY on the official report of the Bureau of Surveys, New York Board of Fire Underwriters, Frank H. Alcott, Jr., assistant to the consulting engineer, said:

> "Wired glass on elevator enclosures was not involved in the fire. Quoting from the report with respect to wired glass windows:
>
> "'Wired Glass windows of proper design are an admirable means of mitigating the rapidity with which a fire can spread. In this case the fire on the 35th floor undoubtedly spread rapidly because the thin glass in the exterior windows broke early from the heat, and aided materially to the combustion. While the fire did not overlap to any extent to the floor above, it might easily have done so under less favorable wind conditions.'
>
> "From our own observations, we noted that considerable smoke damage passed from the filing room immediately involved in the fire through a corridor partition to adjoining offices by means of ordinary glass panels in door and transoms. Had such glass been standard wired glass and the doors and other openings equipped with self-closing devices, it is highly probable that much of the said damage would not have obtained."

The Board of Fire Underwriters is publishing a complete report of their investigation.

Pittsburgh Plate Glass Company Annual Report

The annual report for the year ending December 31, 1926, of the Pittsburgh Plate Glass Company was submitted to the stockholders by W. L. Clause, chairman of the board of directors and C. W. Brown, president, at the annual meeting held in Pittsburgh on March 10, 1926.

The net earnings for the year were $12,122,810.95, after deductions for depreciation, depletion and obsolescence amounting to $3,787,859.38, and for estimated Federal Taxes on Income the sum of $1,600,000. Federal Incomes Taxes paid in 1925 on 1924 earnings amounted to $1,811,702.09. Cash dividends paid in 1925 amounted to $8,826,334.00. Surplus account at January 1, 1926, was $31,920,809.68, compared with $28,911,034.82 at January 1, 1925.

The construction program for 1926 includes the completion of the following: the 2nd unit of Creighton plate glass plant; the electrical installation for Crystal City plate glass plant.

Refractories Institute Annual Meeting

The annual meeting of the American Refractories Institute will be held in Philadelphia, Pa., on May 12, at the Bellevue-Stratford Hotel. Plans are under way to have a number of papers presented by technical and practical men of the industry, and floor discussions of these papers will be invited. In addition, several prominent speakers will be asked to talk on topics of the day. Those who attend the meeting should plan to stay for dinner in the evening. Non-members are invited to attend both the business session and banquet.

Plate Glass Tariff Investigation

The U. S. Tariff Commission, it is understood, has virtually granted the request made at the November hearing at Washington, D. C., by David J. Gallert, who appeared for the Association of Foreign Glass Consumers and suggested that the Commission, instead of reaching a decision on the question of reducing plate glass tariff rates, adjourn the hearing and ascertain new production cost figures on the basis of the so-called new continuous process of making plate glass, which he claimed was not in commercial operation at the time the Commission's preliminary statement of costs was compiled and therefore was not covered by the statement.

A partial investigation of the new process has been made and further researches will be carried out in the field by a number of accountants, economists and a technical expert, who will visit the centers of development of the new process. J. M. Albertson, who has previously made extensive investigations into production costs, will sail for Belgium early in April to ascertain costs in factories there which heretofore have been inaccessible to government investigators.

February Plate Glass Production

During the month of February, 10,543,757 square feet of plate glass were produced, making the total for the first two months of this year, 21,272,434 square feet, as compared with 17,241,924 square feet in the same period of 1925, an increase of a little over 4,000,000 square feet.

P. A. Hughes, secretary of the Plate Glass Manufacturers of America, who issued the figures, thinks it is a little too early to make any predictions as to what the total for this year may amount to, but the increased production for the first two months would indicate that the total production for 1926 will largely exceed the production for 1925.

Glass Container Annual Meeting

The Glass Container Association will hold its annual meeting at Montreal, Canada, on Thursday and Friday, April 29 and 30. The association announces that the Mayor, hotels, and civic organizations of Montreal are going to turn the whole city over to the visitors and that "Brothers Grier, King and McDonald of the Dominion Glass Company, who know Montreal and are kings among entertainers," will be there. Four sessions will be held during which speeches will be made, reports presented and some business matters of vital importance discussed. A banquet and entertainment will be held on Friday evening. Members are urged to bring the ladies for whom special entertainment will be provided.

Pittsburgh A. C. S. Meeting

At the last meeting of the Pittsburgh Section, American Ceramic Society, March 24, 1926, J. W. Cruikshank, of the Cruikshank Engineering Company, past chairman of the section, read an illustrated paper on "The Development of Drawing Sheet Glass As Shown By Patent Office Records." Application of the patents to the industry and their shortcomings were ably pointed out by Mr. Cruikshank.

The officers of the section for 1926-1927 are as follows: E. J. Casselman, Chairman, Mellon Institute, Pittsburgh, Pa.; C. E. Fulton, Vice Chairman, Pittsburgh Plate Glass Co., Tarentum, Pa.; G. R. Pole, Treasurer, Mellon Institute, Pittsburgh, Pa.; C. H. Geister, Secretary, Mellon Institute, Pittsburgh, Pa.

The report of the Standard Plate Glass Company and its subsidiaries for the year ended December 31, 1925, showed a

profit of $326,178, after deductions for depreciation, interest, etc. This is equivalent, after paying 7% dividends on prior preference stock, to $3.80 a share earned on 49,914 shares of 7% preferred stock. This compares with net profit of $861,512, after federal taxes, or $1.73 a share, on 200,000 shares of no-par common stock after preferred dividends, in 1924.

At a meeting of the Lancashire and Cheshire Antiquarian Society held in the great hall of the Chatham Hospital, Manchester, England, Walter Butterworth, a well known glass manufacturer and managing director of Butterworth Bros., Ltd., delivered an address on "Characteristics of Stained Glass." Mr. Butterworth traced the whole history of stained glass from its beginning to the time of its greatest magnificence in the first half of the sixteenth century. The lecture was illustrated by a large number of lantern slides of windows both in the English Cathedrals and abroad.

The United States Glass Company earnings for 1925, announced at Pittsburgh, showed a notable improvement over those of the previous year although operating at only about 60 per cent of capacity. Net earnings, after deducting $195,227 for depreciation, amounted to $180,376 or at the rate of 7.4 per cent on outstanding stock. Large loans were paid off and the company is now free of all mortgage indebtedness.

Trade Activities

The Fort Pitt-Jeannette Glass Company, Jeannette, Pa., has been incorporated to manufacture and sell glass.

A comprehensive exhibit of 65 items of **Corning Glass Works'** art glass products from their Steuben Division factory is being held at the Ferargil Galleries, 37 East 57th street, New York.

The Twin Lock Glass Container Company, Millville, N. J., has been incorporated with a capital stock of $250,000. The incorporators named are: Irving A. Green, Harry I. Raup and Eva Black.

A building housing one of the tanks at the **Whitall-Tatum Company's** Millville, N. J., plant was destroyed by fire on March 21 with a heavy loss, although four automatic machines were not seriously damaged.

The United States Glass Company has put its No. 1 tank at its Gas City, Ind., plant into operation giving employment to at least a hundred additional persons. The No. 1 tank has not been in operation for over a year.

The Central Glass Company of Virginia, Inc., Bristol, Va., has completed a new installation of automatic polishing machinery and other equipment in connection with a new plant addition. D. F. Collins is general manager.

The Bridgeport Lamp Chimney Company, Bridgeport, W. Va., resumed operations early in March after a two months' shutdown, and, it is reported, will continue to operate until the end of the present season, about July 1.

The Central Glass Company, of Chattanooga, Tenn., manufacturers of mirrors and dealers in glass, has been purchased by O. J. Hubbuch and the name will be changed to the **Hubbuch Glass Company.** It is reported that the purchase price was between $75,000 and $100,000.

L. Solomon & Son, 199 Wooster street, New York, largest importers of polished plate glass and of numerous other glass products, are opening a new warehouse at Galveston, Tex., which will enable the company to better serve its customers in the southwestern part of the country.

The Davies Glass Manufacturing Company plant at Martin's Ferry, O., was recently sold at a sheriff's sale to Myron E. Cole of Martin's Ferry, who is reported to be representing the bondholders, the purchase price being $63,350, which is two-thirds the appraised value. The Davies Company went into bankruptcy over a year ago.

J. F. Rogers, chief engineer, gas producer department, **Wellman-Seaver-Morgan Company,** will on April 6, at 8 p. m., address the Cleveland Section of the American Society of Mechanical Engineers at the Hotel Winton on "Mechanical Gas Producers." In the afternoon the members will be taken on an inspection trip through the Wellman-Seaver-Morgan Company plant.

The Bay Cities Glass Company recently incorporated by L. C. Gould, president; J. F. Scott, secretary; G. A. Thatcher, treasurer, and Adolph Wichner and J. Kuester, are reported to be contemplating the remodeling of the Hermosa Glass Company, at Hermosa Beach, Cal., which they expect to acquire. The plant will be equipped as a modern window glass factory.

The Lynchburg Glass Works' plant at Lynchburg, Va., was recently purchased by Robert W. Massie for the benefit of the bondholders. The property, buildings, etc., which originally cost $325,000 was sold for $18,000. The company, which operated until May, 1925, did not pay the interest on their bonded debt and the trustee foreclosed the deed of trust.

The Spencer Lens Company, Buffalo, N. Y., has purchased the plant of the Monark Knitting Mills, Ltd., on Genesee and Doat streets, Buffalo, at a cost of approximately $250,000. The plant which consists of a four-story building will be remodelled and will house the microscope and other instrument business at present located in the Niagara street plant.

The Irving Cut Glass Company, Honesdale, Pa., suffered a loss by fire on March 6, estimated at $3,000 on the building and $12,000 on stock, which was covered by insurance. Manufacturing operations have been resumed. The officers of the company are: E. V. Coleman, president; Wm. H. Hawken, vice-president; John Gogard, secretary, and W. H. Seitz, treasurer.

The Perfection Plate Glass Company was recently incorporated at Columbus, O., with $6,000 authorized capital by M. R. Alexander, Robert L. Ellery, Mrs. Robert L. Ellery, Robert M. Ellery and J. B. Alexander. It is reported that the company has been organized to sell patent rights for a new machine which, it is claimed, will eliminate grinding in the production of plate glass.

The Torrance Flat Glass Company, manufacturers of mechanically drawn sheet glass, figured, ribbed or rough wire glass, rough cast and figured rolled glass, resumed operations on April 1 under the managership of Frank S. Coates. The Torrance Company was established about seven years ago and operated as a hand plant until about a year ago when it was closed down and equipped with machines.

The Acme Glass Company's plant at Olean, N. Y., was purchased by New York interests for a sum approximately $300,000. The new owners will take possession July 1 and will double the working force and the output of the plant. The present officers, with the exception of J. E. Farrell, who has contemplated retirement for some time, will be retained.

The Kauffeld Illuminating Glass Company, operating the old Star Glass Company at Star City, W. Va., resumed operations early in March on the union wage scale after an attempt of several weeks' duration to operate on a non-union basis, during part of which time the plant was picketed. This was the first time in twenty-five years that such action had taken place at any flint glass plant in that vicinity.

Thomas H. Kurtz, of Pittsburgh, recently announced that he had acquired control of the **United States Refractories Corporation** capitalized at $2,000,000 and it is reported that this will be followed by a combination including the following concerns: Ashland Fire Brick Company, Crescent Refractories Company, Haws Refractories Company, Stowe-Fuller Refractories Company. Mr. Kurtz will be president and general manager and V. P. Wallett, secretary and treasurer.

The Paul Wissmach Glass Company, Inc., manufacturers of opalescent wire and ornamental flat glass, has been reorganized with A. P. Vollmar, succeeding the late Paul Wissmach as president. Other officers of the company are: E. E. Stryker, secretary-treasurer; E. C. Vollmar, assistant secretary and M. S. Vollmar, assistant treasurer and R. S. Feldmeier, factory manager. The company's factory is located at Paden City, W. Va., and the main office in the Brett Building, Long Island City, N. Y.

James W. Gill, president of the **Ohio Valley Clay Company,** Steubenville, O., ever since its organization has disposed of his controlling interest in the company to his nephew, James H. Gill, who has been vice-president for several years and also a large stockholder. The present officers of the company are: James H. Gill, president; C. M. Hollingsworth, vice-president, George H. Cochran, secretary and treasurer. James W. Gill is chairman of the board of directors.

Leary & Sonneborn, Inc., have established offices at 133-137 Front street, New York, and will act as chemical and metal brokers. The firm consists of John P. Leary, who for many years was with the American Smelting & Refining Company, and Lawrence H. Sonneborn, metallurgical engineer and graduate of Columbia University and also formerly with the American Smelting & Refining Company in both a technical and sales capacity.

The Belmont Tumbler Company, Bellaire, O., resumed operations early in March after being idle since December, during which time the plant was remodeled. A department which was recently organized by the company for the manufacture of alkali and acid proof illuminated glass signs by a new process to withstand weather conditions in all parts of the country, is being operated under the name of the Bellaire Glass Company.

The Capstan Glass Company, South Connellsville, Pa., early in March ordered back to work about 150 men and women employees who had been furloughed in December when one of its tanks was shut down for repairs. With the return of the 150 employees the Capstan company has 600 employees on the payroll, according to G. F. Reiman, or about two-thirds of its capacity. It is expected that within a few months the plant will be running to capacity giving employment to about 800 persons.

Personals

J. Earl Frazier, who has been connected as chief chemist with the Berney-Bond Glass Company, Clarion, Pa., has resigned that position and is now associated with the Simplex Engineering Company, Washington, Pa., as chemical engineer.

Marion G. Bryce has resigned as a director of the United States Glass Company, Pittsburgh, Pa. Mr. Bryce who was at one time president and later chairman of the board is now residing in California and decided to resign as he was unable to continue his activities in the affairs of the board.

A. M. Hess has resigned as plant manager of the Huntington, W. Va., plant of the Owens Bottle Company, formerly the Charles Boldt Glass Company, and his place has been filled by D. H. Andrews, formerly assistant plant manager of the Owens' Charleston factory.

Recent Deaths

Harvey Wilson

Harvey Wilson, aged 76, for many years assistant treasurer of the United States Glass Company, died at his hime in Pittsburgh, on March 14. Mr. Wilson was at one time engaged in the soap business but later entered the glass field, becoming a partner in the firm of Jones, Cavitt & Company, glass manufacturers.

Inquiries Received

For Further Information Address: THE GLASS INDUSTRY

321. Kindly advise us where we can get into connection with some company in the old country that is making 7/32 inch thick, or about that thickness, of crystal sheet by the Fourcault process. (Mar. 8)

322. Kindly give us the name of concerns making unbreakable glass tumblers. (Mar. 13)

323. Who makes small glass fish globes about 2 inches in diameter at opening? (Mar. 24)

324. Please give us names of pressed glass manufacturers in Indiana, Ohio, Pennsylvania and West Virginia who are equipped to make articles such as ink wells, desk trays, ash trays, etc. (Mar. 25)

325. We are interested in purchasing a quantity of glass bars and shelves to be used in furthering the sale of our line of built-in tile bathroom accessories. (Mar. 25)

326. We have a foreign client who would be pleased to have the addresses of some American manufacturers of brackets for towel bars. (Mar. 25)

327. We are desirous of obtaining a glass article similar to a milk bottle in shape but open at both ends, with screw threads both ends, and about 5 inches long, will require 50,000 to 100,000 pieces. (Mar. 25)

What the World Wants

Specific inquiries for American goods received in the Department of Commerce

Netherlands. 19,338, glassware.
Bolivia. 19,338, mirrors, very thin, bevel edges, inexpensive.
Australia. 19,408, glassware.
Honduras. 19,605, glassware.
Ceylon. 19,569, glassware; 19,639, glassware and window glass.
Canada. 19,655, glassware (cut).

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, MARCH 23, 1926.

Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

	Bid	Ask	Last
American Window Glass Machine, com....	..	73½	73½
American Window Glass Machine, pfd...	..	90	89¾
American Window Glass, pfd.....	108	110	108½
United States Glass.....	18	18½	18
Pittsburgh Plate Glass, com.....	..	..	290
Standard Plate Glass, com.....	..	..	7¾
Standard Plate Glass:			
Preferred cumulative	..	..	40
Prior	73	..	81

Plate glass is in heavy demand, in a large part due to the high rate of automobile closed car production. The market for window glass and other forms of building glass is easing up slightly. Producers of window glass have in prospect the usual spring rush which reaches the peak about May 15th. A reactionary stock market has adversely affected the price of some of the glass securities.

WHEELING STOCK EXCHANGE, MARCH 23, 1926.

	Bid	Ask	Last
Hazel-Atlas	..	..	40
Imperial	..	..	72
Fostoria	..	..	150
Central	..	..	75

TOLEDO STOCK EXCHANGE, MARCH 23, 1926.

	Bid	Ask	Last
Owens Bottle Machine, com.....	..	..	61½
Libbey-Owens Sheet Glass, com.....	..	..	148¾
Libbey-Owens Sheet Glass, pfd.....	..	..	110

Readers Wants and Offers

Superintendent or Glass Maker

WANTED: Position as superintendent or glass maker in bottle factory. Familiar with manufactured or natural gas or oil. Also furnace construction. Can furnish first class references from former employers. Address John Finkbeiner, Box 502, Okemah, Okla.

Window Glass Salesman

WANTED: Thoroughly experienced window glass salesman to call on jobbers and sash and door manufacturers in territory east of Mississippi. Applicant must be a salesman of recognized ability and good reputation. Give full particulars in first letter. Address, J. Parkin, 2300 Division Street, St. Louis, Mo.

Back Numbers of Glass Industry

THE TOLEDO (OHIO) PUBLIC LIBRARY in order to have a complete set of copies of the GLASS INDUSTRY in the new glass section desires to obtain the issues of November and December, 1920, all issues of 1921, and February and March, 1922, either as gifts or for purchase. Kindly address CARL VITZ, Librarian.

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers

March 23, 1926

		Carlots	Less Carlots
Acid:			
Citric	lb.	.45	.45
Hydrochloric (HCl) 20° carboy extra per 100	lb.	.90	1.00
Hydrofluoric (HF) 60% (lead carb.)	lb.	..	.13½
52% and 48%	lb.	..	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.25	5.50
Sulphuric (H_2SO_4) 66°	ton	14.00	15.00
Tartaric	lb.	..	.29
Alcohol, denatured	gal.	.42	.60½
Aluminum hydrate (Al (OH)₃)	lb.	.06	.07
Aluminum oxide (Al_2O_3)	lb.	..	..
Ammonium bifluoride (NH_4) FHF	lb.	..	.23-.23¼
Ammonia water (NH_4OH) 26° drums	lb.	..	.04
Antimony, metallic (Sb)	lb.	..	.21½
Antimony oxide (Sb_2O_3)	lb.	..	.18-.18½
Antimony sulphide (Sb_2S_3)	lb.	..	.18
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.93½	.04
Barium carbonate ($BaCO_3$)			
Precipitated	ton	46.00-50.00	51.00-54.00
Natural powdered	ton	42.00-44.00	45.00-46.00
Natural, powdered, imported	ton	38.00	40.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05
Barium nitrate ($Ba(NO_3)_2$)	lb.	.07¼	.08
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05½	.06½
Borax ($Na_2B_4O_7 \cdot 10H_2O$)	lb.	.04¾	.05-.05½
Boric acid (H_3BO_3)	lb.	.09	.09¾
Refined	lb.	.08½-.09	.09-.09½
Cadmium sulphide (CdS)—			
Red	lb.	..	1.25
Orange	lb.	..	1.10-1.25
Yellow	lb.	..	1.40
Chromium oxide (Cr_2O_3)	lb.	.30	.31-.32
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25
Black prepared	lb.	..	.30
Cryolite ($Na_3Al\ F_6$)	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.30
Feldspar—			
100 mesh	ton	12.50-20.00	16.00-22.00
80 mesh	ton	..	..
40 mesh	ton	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	..
" " 90%	ton	38.00	..
Formaldehyde	lb.	.09	.09½
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02-.02¼
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.12¼	.12½
Litharge (PbO)	lb.	.11¾	.12
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls. Per bbl.		2.15	2.30
Limestone ($CaCO_3$)	lb.	..	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.04	.04½
light (in bbls.)	lb.	.22	.24-.25
extra light (in bbls.)	lb.	..	37
Magnesium carbonate ($MgCO_3$)	lb.	.06¼	.06¾
Manganese 85% (MnO_2)	lb.	.05	.05½
Nickel oxide (Ni_2O_3), black—			
for nickel content	lb.	..	.35
Nickel monoxide (NiO), green—			
for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08¼	.08½
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.06¾
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	.27
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.07⅝
Potassium nitrate (KNO_3) (gran.)	lb.	.06⅛	.06¾
Potassium permanganate ($KMnO_4$)	lb.	.14½	.15¼
Powdered blue	lb.	..	.24-.25
Rochelle salts, bbls.	lb.	..	.20
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.20	.25
Salt cake, glassmakers (Na_2SO_4)	ton	20.00-22.00	23.00-30.00
Selenium (Se)	lb.	..	2.10-2.15
Silver nitrate ($AgNO_3$)	oz.	..	.47¼
Soda ash (Na_2CO_3) dense, 58%—			
Bulk Flat per 100 lb.		1.35-1.40	..
Bulk, on contract Flat per 100 lb.		1.35	..
In barrels Per 100 lb.		1.69	2.40
In bags Per 100 lb.		1.45	..
Spot orders .05 per 100 lbs higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06½	.06¾
Sodium hydrate (NaOH) (caustic soda) Per 100 lb.		3.60	4.16
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04⅛
95 per cent. Per 100 lb.		2.72	2.85
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.04¼	.05
Sodium uranate (Na_2UO_4)	lb.	..	1.15
Sulphur (S)—			
Flowers, in bbls. Per 100 lb.		3.35	3.65-3.90
Flowers, in bags Per 100 lb.		3.00	3.30-3.55
Flour, heavy, in bbls. Per 100 lb.		2.65	2.95-3.20
Tin chloride ($SnCl_4$)) (crystals)	lb.	..	.43
Tin oxide (SnO_2) in bbls.	lb.	..	.68
Uranium oxide (UO_3), 100 lb. lots	lb.	..	..
Zinc oxide (ZnO)	lb.	.07½	.07¾

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to February, 1926

		January 1925 Quantity	January 1925 Value	January 1926 Quantity	January 1926 Value	Seven Months Ending January 1925 Quantity	Seven Months Ending January 1925 Value	Seven Months Ending January 1926 Quantity	Seven Months Ending January 1926 Value
Glass and glass products (total)		.....	$624,903	.....	$673,381	.....	$4,758,921	.....	$5,003,988
Plate and window glass—									
Window glass, common, box 50 sq. ft.		873	6,477	4,815	23,144	20,913	100,896	15,521	81,317
Plate glass, unsilvered, sq. ft.		103,196	24,390	119,612	27,967	890,477	247,685	948,816	230,793
Other window and plate glass	lbs.	96,750	12,229	132,252	19,907	1,176,086	118,784	1,497,575	172,915
Glass containers (bottles, vials and jars)		.....	213,427	.....	214,202	.....	1,655,086	.....	1,586,921
Table glassware, plain		.....	137,361	.....	110,803	.....	1,033,374	.....	1,024,054
Table and other glassware, cut or engraved		.....	6,005	.....	11,521	.....	107,383	.....	101,295
Lamp chimneys and lantern globes	lbs.	156,024	24,893	205,528	35,500	1,118,584	193,270	1,072,921	219,077
Globes and shades for lighting fixtures	lbs.	109,022	38,369	145,903	47,869	830,526	237,624	1,040,419	309,065
Chemical glassware	lbs.	21,351	16,503	18,588	17,228	158,650	124,069	135,211	127,490
Electrical glassware, except for lighting	lbs.	144,534	19,120	522,089	35,615	1,008,772	121,296	1,505,232	167,736
Other glassware		.....	126,129	.....	129,625	.....	819,454	.....	983,325

IMPORTS

Corrected to February, 1926

Glass and glass products (total)		.....	1,223,377	.....	1,412,137	.....	10,024,660	.....	10,206,164
Cylinder, crown and sheet—									
Unpolished	dut. lbs.	3,724,835	202,171	5,358,889	226,377	18,432,606	1,015,834	24,444,113	1,213,111
Bent, ground, beveled, colored, painted, etc., and polished	dut.	.....	41,289	.....	67,783	.....	277,230	.....	303,502
Plate glass	dut. sq. ft.	1,202,872	546,090	2,043,239	626,927	9,074,934	4,299,561	10,377,143	3,780,316
Containers—bottles, vials, etc.	dut.	.....	17,999	.....	36,418	.....	99,212	.....	134,044
Table and kitchen utensils	dut.	.....	5,393	.....	3,679	.....	106,190	.....	103,709
Glassware, cut or decorated	dut.	.....	158,748	.....	173,958	.....	1,340,584	.....	1,611,370
Blown glassware, n.e.s.—									
Bottles, ornaments, etc.	dut.	.....	55,629	.....	41,125	.....	1,311,487	.....	1,304,602
Bulbs for electric lamps	dut. No.	952,212	8,424	1,674,945	15,830	9,645,515	115,356	8,031,252	86,647
Chimneys, globes, shades, etc.	dut.	.....	97,502	.....	77,945	.....	659,976	.....	576,026
Articles and utensils for chemical, scientific and experimental purposes	dut.	.....	23,617	.....	46,848	.....	193,269	.....	286,601
Other glassware	dut.	.....	66,515	.....	95,247	.....	600,961	.....	806,236